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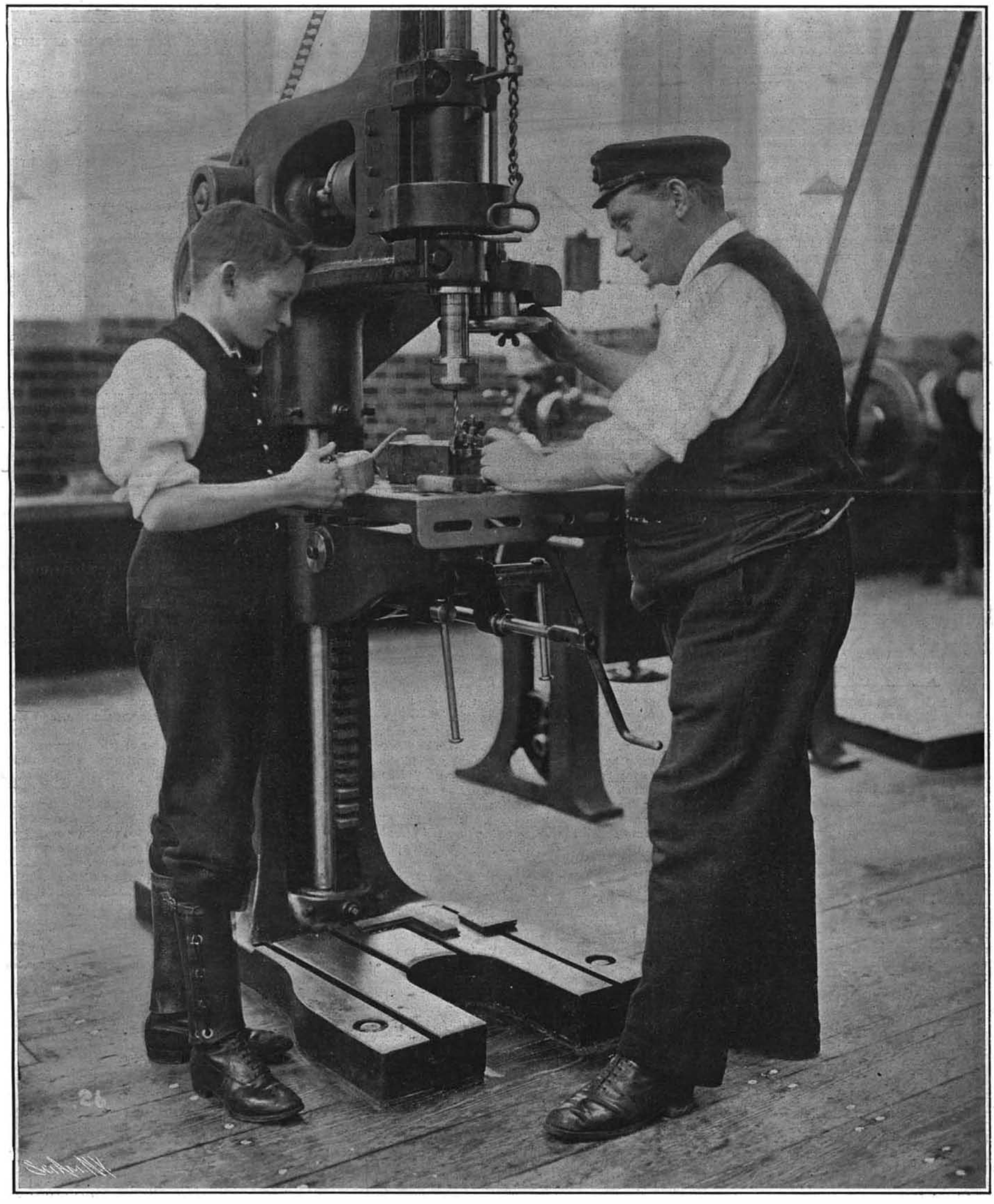
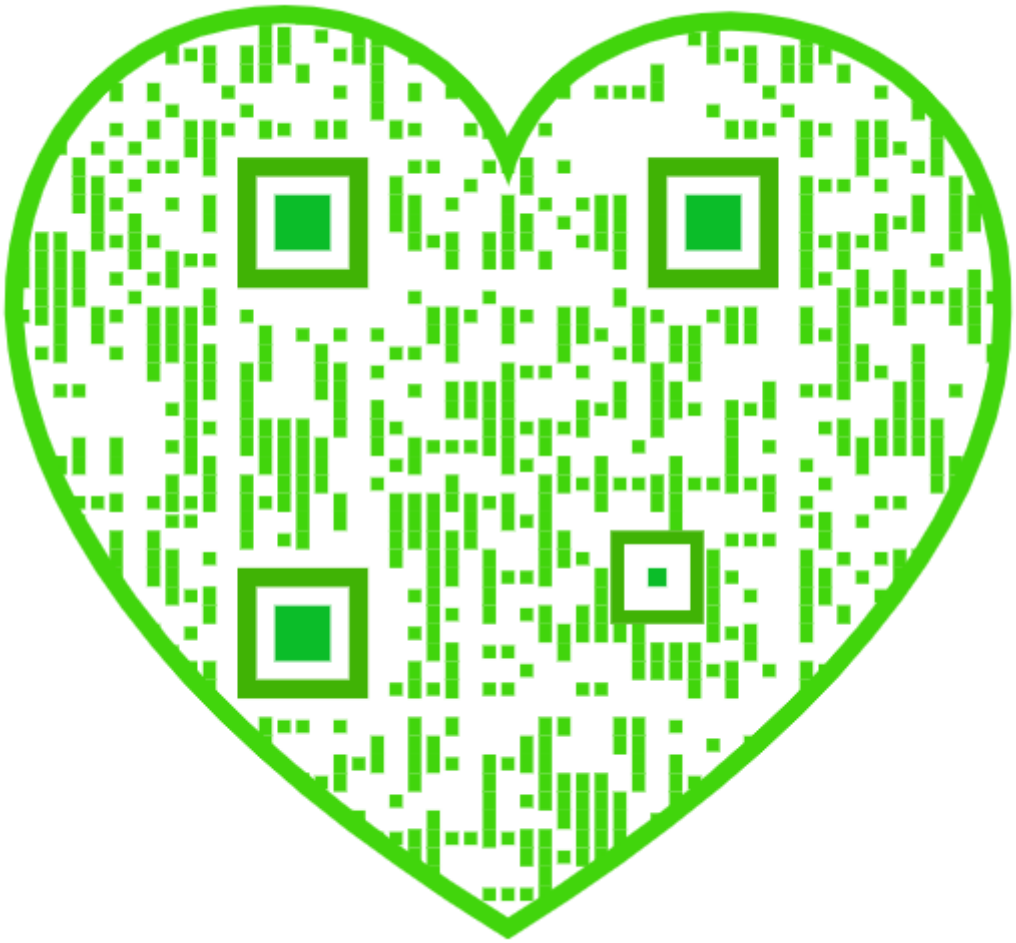


Instruction in the Use of Machine Tools, Osborne College, England.

OSBORNE COLLEGE: AN ENGLISH NAVAL SCHOOL.—[See page 48.]



SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AROUND THE WORLD IN FORTY DAYS.

The prophetic and lively imagination of the late Jules Verne recorded one of its most daring flights, when he wrote that entertaining work, "Around the World in Eighty Days"; and it is probable that none of us who read its chapters supposed that he would live to see the day when the Frenchman's estimate of eighty days would be cut in half by an enterprising officer of the British army, who set out to test the speed of modern around-the-earth travel for himself. In a recent letter to the London Times Lieut.-Col. Burnley Campbell wrote that he landed at Dover on the 13th of June at the completion of a trip around the world which occupied forty days and nineteen and one-half hours. He left Liverpool on May 3 at 7:20 P. M., reached Quebec at 3 P. M. May 10, and was at Vancouver on the Pacific coast at 5 A. M. on May 16. Leaving there about noon of the same day, he reached Yokohama on May 26, Tsuruga on May 28, and leaving there by steamer at 6 P. M., he reached Vladivostock May 30. Here, after a wait of about four hours, he took a Trans-Siberian train, reaching Harbin on May 31, Irkutsk on June 4, Moscow on June 10, and Berlin on June 12. On the following day he was at Ostend, which he reached at 7:30 A. M., and at 2:50 P. M. of the same day he landed in England at Dover. Throughout the whole trip Lieut.-Col. Campbell was remarkably fortunate in making connections; otherwise his time would have been several days longer.

STEADY IMPROVEMENT IN NAVAL GUNNERY.

In the last analysis of the efficiency of a navy, it must be acknowledged that there is no test so reliable as that of the results in routine target practice. In estimating the offensive qualities of two warships it is futile to compare merely the number and caliber of the guns carried by each, since the comparative results arrived at may be completely upset by the extraordinarily good gunnery on one ship, or the bad shooting of the man behind the gun on the other.

The ships of the United States navy are distinguished to-day, as they have always been, by the large number and heavy caliber of the guns which they carry. In the famous duels of our naval history, the commanders of our ships have been quick to take advantage of this fact, and have aimed to disable the enemy by a quick concentration of well-aimed fire from a large number of guns. Thanks to the fact that our naval constructors have lived up to the traditions of the past, we have in commission to-day ships, like those of the "Connecticut" and "Georgia" class, which carry an armament more numerous and powerful than that of any ships of the date at which they were designed. If the marksmanship of our gunners can be brought up to the high standard of the batteries which they serve, that is, if they can acquire the coolness, speed, and accuracy which are necessary to do justice to the modern rapid-firing gun, big or little, then our navy may proudly claim that when its ships draw up in line of battle, they will stand more than an even chance to crush the enemy, as of old.

In common with the leading navies of the world, and particularly of Great Britain and Germany, the United States navy has been giving special attention, during the past decade, to the question of gunnery. Vast sums of money are appropriated yearly for target practice, which is so carried out as to closely reproduce the conditions of actual warfare. Competition is encouraged, and a spirit of keen emulation has been promoted among both officers and men. There has been developed a strong rivalry not only between the individual ships of the various fleets, but among the fleets themselves. The inevitable result has been that the marksmanship of our gunners has steadily risen in accuracy. It is gratifying to learn from a recent general order promulgated by Secretary Metcalf of the Navy, that excellent progress continues to be made. The Atlantic fleet, which is the winner this year, scored 59.34 per cent of hits against 59.24 per cent for the Pacific fleet. The "Illinois" won the battleship trophy with a score of 75.79 per cent. The "Boston" won the cruiser trophy with 79.99 per cent; the "Princeton" the gunboat trophy with 73.40 per cent; and the "Preble" won the destroyer trophy with the score of 78.82 per cent. Not only are these percentages high for the individual ships, but the average final merit of all ships has a high ratio as compared with that of the winning ship. Moreover, this ratio is considerably higher in 1907 than it was in 1906. Last year the average final merit of all ships was 64 per cent of the highest final merit; and this year it has risen to 71 per cent, which marks a most gratifying increase in the general excellence of the shooting.

RELATIVE RISK OF OVERHEAD AND THIRD-RAIL CONDUCTORS.

It will be within the memory of our readers that when the New York, New Haven, and Hartford Company announced that it would make use of the single-phase system for the electrification of its lines from Stamford to New York, a spirited controversy was provoked between the New York Central and New Haven companies, or rather between the two electrical companies which have in hand the respective electrical equipment of the two roads. Mr. Sprague, representing the direct-current, third-rail system, considered that, as the direct system was to be used at the Grand Central terminal and yards, and over the stretch of twelve miles of track to Woodlawn, and as the New Haven Company would have to use these lines and this terminal, they should have made use of the same electrical system, instead of complicating the problem by installing the alternating-current single-phase. To this Mr. Westinghouse, representing the New Haven equipment, replied that the single-phase system was chosen purely on its merits, and because, both on theoretical and practical grounds, it commended itself to the company as being the best suited to the conditions of their service.

Although the New York Central Company have had their electric zone in operation for a period of six months, the New Haven equipment still hangs fire, despite the fact that a large number of electric locomotives are on the ground, and the overhead trolley equipment has been practically finished for several months. Such trains as have been run over the New Haven system have been of a purely experimental character, carrying no passengers; and it must be confessed that the considerable number of accidents, fatal and otherwise, which have already occurred with these experimental and work trains, is far from reassuring as to the safety of an overhead catenary system carrying 11,000 volts in the trolley wire. Several accidents occurred to the erection gang during the stringing of the wires; but this is not so serious as the fact that there have been two or three cases of fatal accident to the brakemen engaged in the operation of freight trains. It is only just to the company to state that, as far as the safety of the passengers is concerned, and the protection of the public who live along the route of the line, every precaution has been taken to prevent contact with the wires. But there is no denying that the overhead lines constitute a permanent and fearful peril to the brakemen of freight trains. Ordinarily, the lines are carried at a height of 22 feet above the top of the rails, and this gives ample clearance, even when a brakeman is standing erect on a box car. But where the lines have to be carried below overhead bridges, the trolley wires have to be brought down very much nearer to the top of the cars—probably, in some cases, within two or three feet of them. And it is here that the danger occurs; for it can easily be understood that the least contact with a wire charged with 11,000 volts may mean instant death.

It is urged, furthermore, against the high-voltage system that, in case of a heavy train leaving the tracks and colliding with two or more of the lattice-work bridges which carry the overhead lines, it would be possible for 1,000 feet or more of the highly-charged wires to be brought down upon the tracks; and, although the system is equipped with automatic cut-outs designed to meet such a contingency, the idea of 11,000-volt conductors tangled in the wreck of a derailed train can scarcely be contemplated with equanimity.

On the other hand, it must be admitted that the third-rail equipment, as built on the New York Central lines, has proved to be ideal, both from the standpoint of convenience and safety. The conductor rails are underhung from insulated brackets, and the top and sides are so completely covered by wood sheathing, that accidental short-circuiting by trackmen or trespassers could only take place by actual intention. Furthermore, in cases of derailment, as was proved at the Woodlawn wreck early in the year, the third rail will probably be quickly carried away and the current cut out by the train itself. However, a comparative test of the direct-current, third-rail, and the single-phase, overhead system will soon be possible, as the New Haven Company announce that in a few days they will have their electric zone in operation. The present indications are that for terminal and suburban work the third rail has distinct advantages. For long-distance service it is probable that the alternating-current, either single or three-phase, will be universally adopted.

THE LUMIERE SINGLE-PLATE PROCESS OF COLOR PHOTOGRAPHY.

A new process for photography in colors has been brought out at Paris by Messrs. Auguste and Louis Lumière, who are among the leading *savants* of France in this department of science. They are able to take a photograph in colors upon a single plate and in an ordinary camera, with exposures of one second or less. This is done by the use of a specially prepared plate. The plate is formed by placing microscopic colored particles upon a glass plate and covering these with a layer of gelatino-bromide emulsions. Three colors are used for the particles, and they form the color screens for the plate. The microscopic elements which form the light screens are made up of a transparent matter which can be divided into corpuscles of very small size and absorb coloring matter very well. It is found that potato starch is the best adapted for the purpose. The grains are sifted so as not to exceed 0.010 to 0.012 millimeter (0.0004 to 0.0005 inch) and are divided into three portions, colored respectively orange, green, and violet. After drying, they are intimately mixed and then dusted upon a glass plate covered with an adhesive coating. In 1904 Messrs. Lumière were able to place three thousand grains per square millimeter (about 2 million per square inch) avoiding all superposition. But spaces were left between the grains, which had to be filled up to prevent white light from passing. For this purpose an impalpable carbon powder was used, and under the microscope the plate showed colored disks upon a black ground. Since then the inventors have improved the process considerably. By means of the proper machinery they are able to deposit no less than 9,000 grains per square millimeter (5.5 million per square inch) and owing to a rolling of the plate at very high pressure, the grains are crushed and flattened so as to form a colored mosaic without any empty spaces. The use of carbon powder is retained, but this appears only as a fine line. By this means we have a considerable reduction of the grain of the image so as to have a projection of some size without making the colored elements visible, and second, an increase in transmission and a reduction of the time of exposure of the plate.

Thus prepared and viewed by transmitted light, the plate does not show any coloration, as the microscopic elements having the colors orange, green, and violet combine so as to give white light. It now remains to sensitize the plate. The layer of colored grains is first covered with a waterproof varnish which has an index of refraction about the same as that of the starch grains. Then comes a layer of gelatino-bromide emulsion which is rendered perfectly panchromatic and is sensitive to all the colors.

The method of operating in the camera is as follows: An ordinary camera is used, and the lens has a color screen of special form such as is needed for the color-plate. The plate is placed in the plate-holder in the dark, with the back of the plate upward, so that the light passes through the granular layer before reaching the gelatine. Using a very luminous lens which can be worked at *f* 3, for instance, the exposure can be lowered to 1/7 second in sunlight, and at *f* 8 good results can be obtained with one second exposure. To illustrate, we may take as a colored object the American flag with the three colors, red, white, and blue. The blue rays will be absorbed by the orange particles, leaving the greens and violets to act on the emulsion. Upon developing, the silver bromide will be blackened under the green and violet particles and the plate will be transparent under the orange particles. In the white part of the flag the light will not be absorbed and will give an effect on the plate under all the colored particles. When developed, we have the surface entirely black. As to the red rays, they will be absorbed by the green particles but will pass by the violet and orange, and the latter portions will appear black. Such a plate when developed and fixed as usual will give the complementary colors of the original, and the flag will appear in orange, black, and green. Theoretically, a second prepared plate applied to this negative should give upon development a positive image which shows the natural colors of the subject. In practice the re-

sult is not very good, because the sensitive layers cannot be well placed in contact and owing to the inevitable loss of the brightness of the colors. The inventors, instead of fixing the developed plate as usual in the hypo bath, dissolve the reduced silver by means of the acid permanganate of potash method, then in daylight they proceed with the second development or reversal, which changes the plate to a positive plate and thus gives the actual colors of the object without needing a second plate. Thus in the first band, the reduced silver bromide which stops off the violet and green particles (leaving the orange) will dissolve in the permanganate bath. Upon placing in the reversing bath, the non-reduced bromide will now blacken under the orange particles. These will be masked, and as the green and violet are now uncovered, their mixture will give the sensation of blue for the first band. In the same way the black band will become white and the green, red, giving the original colors. For other shades of color the action is the same, and each colored particle lets the light pass which is needed for reproducing that special shade.

As to the manipulation of the plate, it is scarcely more complicated than for an ordinary plate. The first development by pyrogallic acid and ammonia is done in the dark quite automatically in a fixed time of 2½ minutes, which can be timed by an hour glass, keeping the plate away from the rays of the red lamp. After a good washing, the plate is plunged in a bath of acid permanganate and now white light can be used. In a few minutes the reduced silver is dissolved and the colors begin to appear, but they are faint. After washing, a second development is made by a diamidophenol bath, and this blackens the silver which is not reduced by the first development, giving a much greater brightness to the colors. After a rapid passage in a bath of dilute permanganate, the plate is intensified in a bath of pyrogallic acid and silver nitrate, when the colors become very brilliant. The plate is placed in neutral permanganate and then in an ordinary fixing bath. The operations are carried out rapidly and the whole takes but 15 or 20 minutes to obtain the colored plate. As the gelatine layer is nine or ten times thinner than the ordinary layer, the washings are reduced to a few minutes, and the drying is very rapid. A special varnish is added which increases the transparence and brightness of the colors, and protects the plate.

If the manipulations of the plate are simple, on the other hand the practical difficulties in the manufacture of the plates were considerable. A sifting process had to be devised which would give the grains of the proper diameter, then after coloring the grains they had to be well mixed so as to have a uniform layer. The colors must be permanent, and the grains spread on the plate in a single layer. A varnish had to be invented which was waterproof in a very thin layer and having an index of refraction near that of the particles, and this was a difficult point. The gelatine layer must be as sensitive as possible and be panchromatic, but as the best of panchromatic preparations give a much greater effect for the blue and violet, a yellow screen is needed for the camera, of special composition. One advantage of the new plates is that they give no halation. This phenomenon is due mainly to the reflection of the rays on the front surface of the glass plate, and the rays are sent upon the sensitive film with an intensity proportional to the thickness of the glass. Another cause is the diffusion of the light in the gelatine layer itself. In the new plates the first cause is quite suppressed, since the plates are placed backward. As to the diffusion in the layer, it is scarcely appreciable, owing to the very thin layer which is used. For these reasons there is scarcely any halo, and operators can take interiors, cathedral windows with brilliant colors, and especially the glowing colors of the sunset.

The process invented by Messrs. Lumière thus marks quite a step in advance, and color photography will no doubt come into extensive use. Besides the great interest for amateurs, it will render service in the different sciences. Explorers will thus have geographic, ethnologic, and botanic data of value. In astronomy, the new plates will be specially valuable for registering with scientific accuracy the colorations of phenomena of short duration, such as solar eclipses, Aurora borealis, solar halos, etc. In medicine we will have colored plates for anatomy and surgery. The time may not be far distant when we will be able to make colored photographic prints by an analogous method from such plates. At present, mechanical reproductions have already been made. L'Illustration was the first to demonstrate this and by the use of the well-known three-plate process it was able to publish some very fine views, in color, which for a first attempt are remarkable. Among these are a portrait of the king and queen of Norway, taken at Paris, also a view of soldiers, fruit and flowers, and a sunset on Lake Leman. A public demonstration of the process was made by the inventors at the lecture hall of the journal and aroused great interest.

THE RAIL SITUATION.

BY J. KENT SMITH.

The practical importance of the subject is supreme, for it is a case where the momentous elements of public safety and human life are involved, so that no cheeseparing in first cost can be considered; for such economy is ethically inadmissible, if it be gained at the expense of human safety.

The contention that the open-hearth rail must replace the present Bessemer rail is without a shadow of doubt absolutely sound, as not only can a steel of much greater purity be obtained as far as the usual elements reckoned injurious are concerned, but the open-hearth process admits of far greater regularity in product, and the liability of over-oxidized steel (a fruitful source of mischief) is greatly minimized. The pernicious effect of oxygen in steel has not received the full amount of recognition and investigation in the past that it should have had. This fact alone, putting aside any question of purifying unsuitable metal by substituting any modification of basic for acid Bessemer conversion, is a strong indication of the advisability of considering seriously a change in the process of the manufacture.

The Bessemer process (essentially a "hit and miss" one) has done yeoman service, and no one can gainsay the inestimable value which it has rendered to us, but *"Tempora mutantur, et nos mutamur in illis"*; and the plain fact is staring us in the face that the practical requirements of to-day have advanced beyond the pale of its usefulness. Thus its supersession should be viewed, not as summarily discharging an old employee who has well and faithfully served us, but rather as granting him an honored and well-earned retirement at the end of his useful period of service.

Here it is advisable to sound a note of warning to the engineer as to hasty deductions on wearing quality based on strictly comparative analytical data, as the careful observations of Harbord, Ridsdale, and Haarman in Europe, amply confirmed by other investigators in this country, show that a higher carbon content is necessary in "basic open-hearth steel" than in "acid Bessemer steel" to secure the same degree of surface hardness and static strength, keeping, of course, static ductility the same.

The manufacturer on the one hand minimizes, and the user on the other hand lays great stress upon, the injurious effects of piping and segregation. The mitigation of these troubles is very largely a question of mill practice; and it must be remembered that such phenomena are due to natural laws, and must be obviated as far as possible in methods of casting, stripping, reheating, etc., no matter what process of steel manufacture is indulged in, or what composition of steel is made. Details of casting temperature, etc., due to differentiation of the manufacturing process, have of course some influence as to their amount, and here again the open-hearth possesses manifest advantages.

Processes of fluid compression, either from the top, bottom, or side of the ingot, and of many varieties, have been devised, but it is entirely in the prevention of piping and segregation that these processes have virtue; for no one could contend reasonably that pressure applied to an incompressible fluid could change its fundamental attributes; and "working" the ingot sees to physical disposition of its components.

It is a moot point with many, if no doubt exists in the mind of the writer, as to whether judicious cropping of the vertically solidified and "soaked" ingot ("bleeding" and "running back the pipe" being thus averted) does not reasonably take care of piping and segregation troubles, when this procedure is rightly followed along the lines of good specifications.

No sane man would gainsay the desirability of absence of both segregation and piping; but the published experience of Mr. J. E. Stead (a most eminent metallurgist whose dicta are authoritative in every sense of the word, and whose experience, crudely but succinctly comprised, points to the fact that segregation generally occurs on the "neutral axis," and that approximately the same proportion of segregated rails leave the mill as are found broken in service) would seem to indicate that attempting to minimize these evils, while undoubtedly a step to the good, does not mean any serious attempt to ameliorate the *real* cause of most rail failures.

Statements have been made in the public press that every rail leaving the mills is already cracked at the junction of the web and flange, as a result of rolling to its present finished shape. To this view I cannot subscribe, though I am willing to fully admit that physical and mechanical considerations necessarily make this the weakest part of the rail.

To my mind the real reason lies in the development of that "potential brittleness" so extensively worked upon by Arnold, which is brought about by the continued hammering and rolling strains, combined with wave motion, due to the passage of heavy traffic at high rates of speed over metal that apparently was ***initially*** **ductile. This brittleness is naturally developed at the weakest part. Therefore we must make the metal dynamically as good as possible, and much better than that now in use, consistently with such reasonable simplicity as makes this end commercially attainable.**

Of all the alloys, vanadium has been proved, both by exhaustive scientific investigation and extended trial, to be so pre-eminent in this property of conferring upon steel resistance to repeated stresses (thus retarding the genesis of the brittleness spoken of) as to practically stand alone; and to its use we must, I am convinced, turn for a true solution of the problem. Nature teaches us the extraordinary value of the element in no uncertain manner, for certain Swedish irons which are distinguished by their "vitality" under trying conditions, contain notable quantities of vanadium.

And here I am able to give a word of encouragement to the steel maker and the consumer as to the ultimate economy attending the alloy's use. It is notorious that those steels which best combine non-brittleness with the presence of the hardening constituent carbide in its emulsified sorbitic form, are also those which wear best with safety; in fact, several processes, more or less elaborate and more or less practical, have been devised for treating carbon rails, in order to attain this sorbitizing action alone.

Now vanadium, when employed in judicious admixture, automatically produces well-disseminated sorbitic carbide; and consequently the first cost of a vanadium rail, comparable on all counts with that of a nickel-steel rail, may be more than repaid by increased duration of service; in which case insurance against accident will have been attained and present troubles overcome at no added expense in the long run.

ENGINEERING NOTES.

Without entering upon the relative merits of different structural materials, we refer here to three railway bridges with spans of 187 feet, 211 feet, and 211 feet, respectively, which have lately been erected in plain concrete on the three-hinged principle. All of the structures were designed by Mr. Beutel, chief engineer to the Bavarian state railways. One of them, at Lautrach, crosses the river Iller, with a main arch span of 187 feet, and two smaller arches at the abutments. As the rise of the main arch is only about one-sixth of the span, the three-hinged system is particularly advantageous. The arch rib in this instance carries cross walls connected by small arches surmounted by the road upon which the permanent-way is laid. The other two bridges cross the river Iller close to Kempten station, where there is a network of several branch lines. One of these bridges carries four railway tracks, and the other only two, but their structural features are practically identical, the main arch of each bridge having the clear span of 211 feet, with the rise of about four-ninths of the span. We are glad to say that all three bridges were finished without the casing of stone or other veneer which some engineers seem to imagine is necessary for decorative effect. It is stated that the cost of the Lautrach bridge was 17 per cent less, and the cost of the two Kempten bridges was nearly 20 per cent less than the estimated cost of steel bridges. The ultimate saving should be considerably more, owing to the fact that practically no maintenance is necessary in the case of concrete structures.

Believing that prompt and effective application of State laws and its own rules is the best preventive of accidents in anthracite coal mines, and realizing that the rules are readily forgotten unless constantly discussed, the Delaware, Lackawanna & Western Railroad has instituted a plan to hold competitive examinations every six months concerning the details of the regulations. State mining laws and company's rules must be on the "tongue's end" of every mine foreman, fire boss, barn boss, or driver boss employed in the D., L. & W. mines. The company's collieries have been divided into four districts, each under a superintendent and assistant. The districts each average about five collieries and examinations in each district will be carried out separately. An examining board, consisting of the general manager, his assistant, and the chief engineer, are to examine the men in a hall specially engaged for the purpose. To each man will be given practical questions to answer. A man's answers will indicate his knowledge of the application of State law or company's rules. After all examinations have been completed, the answers, recorded by a stenographer, will be carefully gone over and receive marks of relative merit. To the district showing the highest average for all men examined, will be awarded a handsome trophy which can be retained until the next competitive examination. If any district wins the trophy three times in succession, it is then to own it. Mine foremen and assistant foremen are examined by boards appointed by the State, before receiving certificates which permit them to hold their positions. The examinations conducted by the company are intended to supplement those prescribed by the State, and it is believed that their effect will be very beneficial.

A NEW AUTOMOBILE BOAT.

BY JACQUES BOYER.

A French inventor, J. Ravaillier, has devised a self-propelling vehicle which can navigate the water like an ordinary motor boat and also travel overland like an automobile. The official tests of the boat, recently made in the presence of M. Barthou, the Minister of Public Works, and other distinguished persons, were crowned with complete success. To tourists who make use of this amphibious vehicle canals, rivers, and lakes will present no serious difficulties, as they can be crossed with ease and comfort wherever moderately gentle and smooth slopes, natural or artificial, can be found for entering and leaving the water.

The hull of the boat, which is made of steel plates riveted to steel ribs of T-shaped section, is mounted by means of springs on axles and wheels of pressed steel. The axles pass through water-tight tubes which traverse the hull. This part of the construction, which is very cleverly designed, is the invention of M. Gustave Pitre, the naval architect of the Maisons Laffitte.

The motor (constructed by Gontallier, of Vincennes) is placed near the bow. It drives, by means of a clutch of the disk type, two distinct systems of mechanism: 1. A variable speed shaft transmits the power to the rear or driving wheels by means of chains and pinions, the arbors of which pass through stuffing boxes. Three forward speeds and one backward speed are provided. Coupling, retarding, and speed-changing levers, a differential brake worked by a pedal, and a brake lever acting on the rear wheels complete the mechanism of propulsion on land. Steering is effected, as in an ordinary automobile, by a wheel connected with the front axle, the shaft of the wheel passing through a stuffing box. 2. The variable speed driving shaft, prolonged backward beyond the rear axle, may be connected, by means of a clutch, with a screw propeller at the stern of the boat, the connection being made by moving a lever placed at the left hand of the driver of the vehicle. The rudder and the front axle are turned by the same steering wheel.

The capstan, which is seen at the bow of the boat, is turned by a tangent screw which is driven by the motor, by means of a wheel and belt, and connected and disconnected by a loose wheel, or idler.

The driving wheels, the propeller, and the capstan can be operated separately or simultaneously.

The speed of the vehicle, as determined by numerous trials, is 35 kilometers (21¾ miles) per hour on land, and 9 kilometers (5.6 miles) per hour in the water.

The boat enters and leaves the water without any preparation or change, except in mechanical connections. When afloat its stability is perfect, as is shown by one of the illustrations. It leaves the water and climbs the bank under the impulsion of its driving wheels if the ground is reasonably firm and the grade less than 15 per cent. If the bank is steeper or softer, a rope is fastened to a stake driven into the ground, and the boat is hauled up by the capstan.

The equipment of the boat is completed by a pump for bailing, an anchor, a buoy, and a pair of oars and movable rowlocks for use in case of accident to the motor while afloat.

The Ravaillier automobile boat seems destined to render valuable services to tourists. The best proof of the practical value of this invention is the fact that it has been purchased, together with all its patents, by an American.

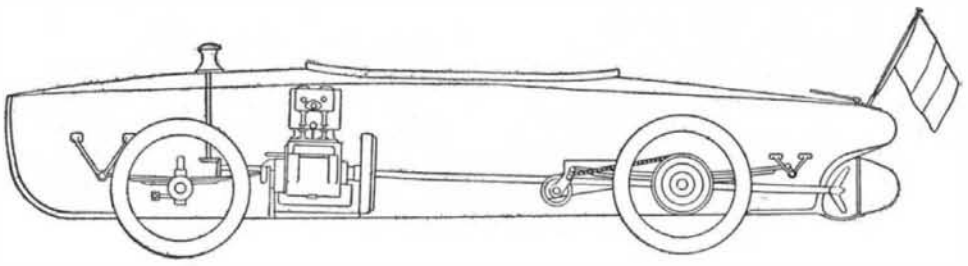
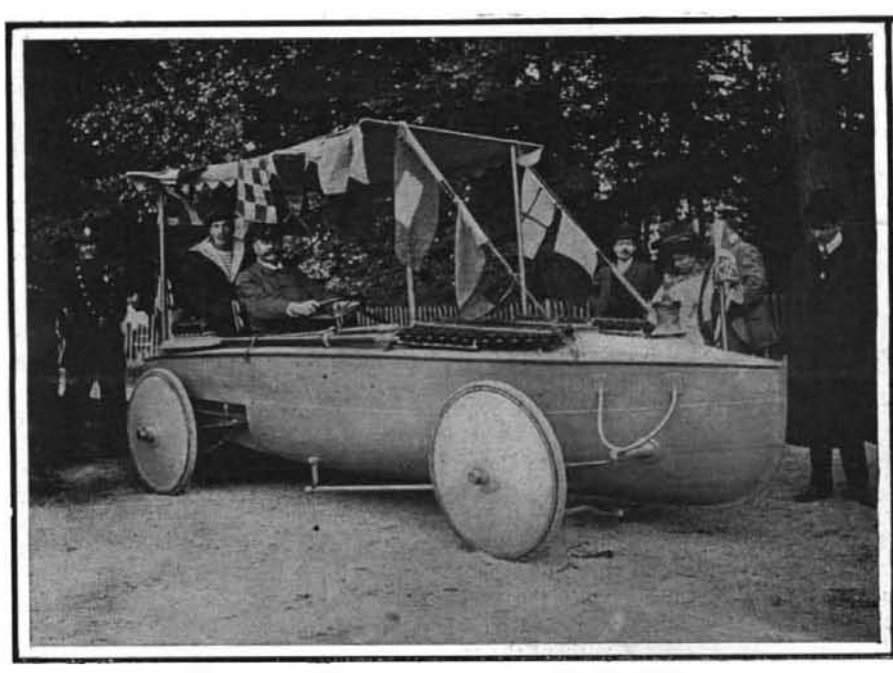
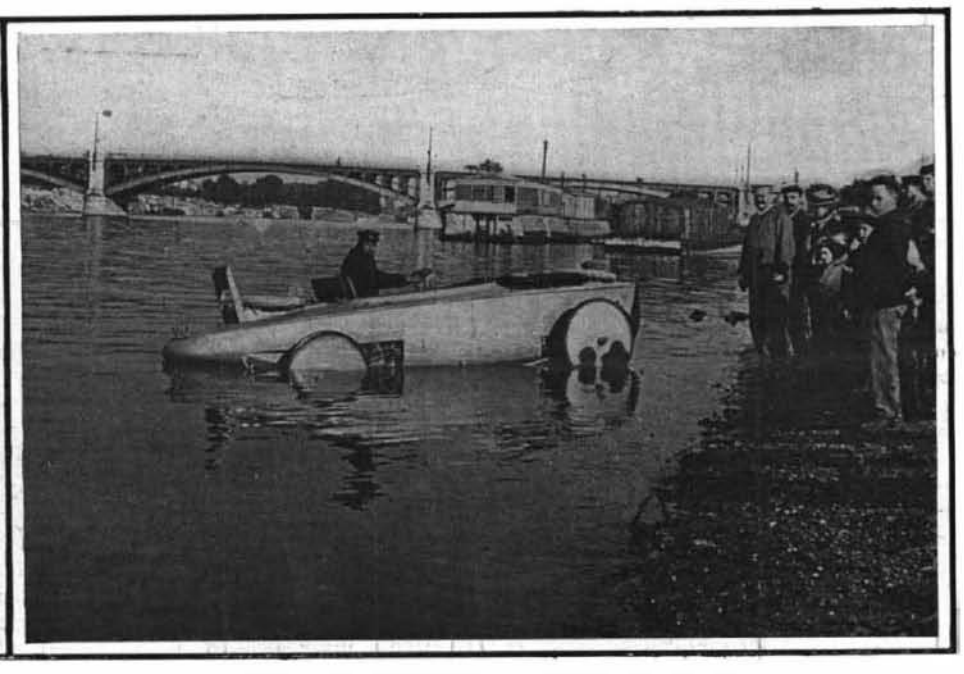


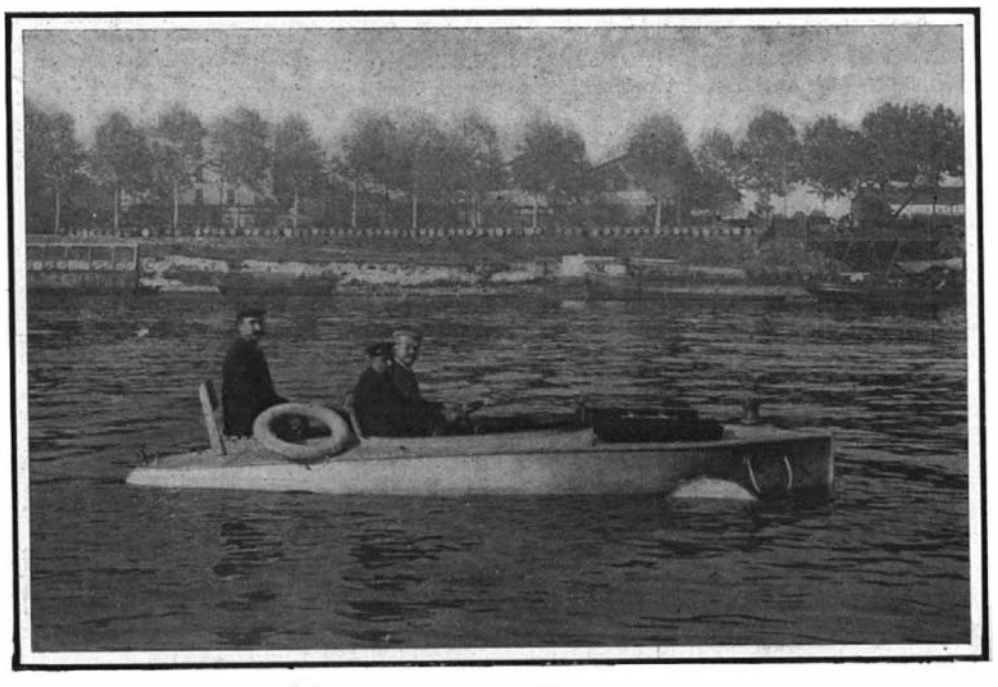
DIAGRAM SHOWING MECHANISM OF THE AUTOMOBILE BOAT.



THE AUTOMOBILE BOAT TRAVELING ON LAND.



THE AUTOMOBILE BOAT LEAVING THE WATER.



THE AUTOMOBILE BOAT NAVIGATING THE SEINE.

Temperature of the Planet Mars.

In a recent communication to the American Academy of Arts and Sciences, Prof. Percival Lowell discusses the probable temperature conditions of the Martian surface, in the course of which he introduces several novel considerations which have not received attention by previous workers on the same problem. Up to the present time the chief obstacle to the acceptance of the belief in the existence of life on the planet has been the extremely low surface temperature assumed to exist. It has been customary to only consider the plant's distance from the sun as the factor; in this way Moulton, by the application of Stefan's law of radiation, found the value —0.33 deg. F. for the mean temperature. Prof. Lowell insists that the planet's distance is only one of several determining factors, and proceeds to discuss minutely the effect of the planet's albedo or reflecting power, the screening action of any clouds which may be present, and the protective value of whatever atmosphere exists. After a discussion of the investigations on solar radiation at various altitudes, by Langley, Very, and others, and taking the earth as being 50 per cent cloud-covered, the earth's mean albedo is taken as 0.75, and that of Mars is computed to be 0.27. Applying now Stefan's law, and including the effect of albedo, the mean annual temperature of Mars is found to be 72 deg. F. or 22 deg. C. This would correspond to the conditions if the heat were retained on Mars to the same extent as it is on the earth. The retentivity is not the same, however, being greater on the earth on account of its denser air covering, and the inclusion of this factor brings down the value of the Martian mean annual temperature to 47.7 deg. F. (8.7 deg. C.). An interesting side issue on this matter leads Prof. Lowell to state that the special brilliance of Venus as compared with the other planets is to be ascribed to the presence of a dense air envelope, from which sunlight is directly reflected. This conclusion is also in agreement with the prolongation of the terminator of the planet as it passes inferior conjunction before the sun.

Reverting to Mars, it is found that five-eighths of the surface is desert, and the mean surface albedo comes to be 0.10, and as the total albedo is 0.27, the albedo of the air envelope will be 0.17.

The air density at the surface is given as 2.5 inches, which would give 111 deg. F. (44 deg. C.) for the boiling point of water. As sublimation will take place more freely on Mars at a given temperature there will be proportionately more water vapor in the air there.

A wealthy Frenchman recently bought a ticket at a Paris railway terminus, but missed the train he intended to take. While waiting for the next one, which left two hours later, he studied the company's tariff to pass away the time. He then found that he had been charged 14 francs 45 centimes, whereas the proper fare was only 14 francs 42 centimes. He asked for his money back at the office, but without result. An interview with the stationmaster was also unsuccessful. He afterward wrote a number of letters to the company, but received no answer. He then commenced an action to recover the three centimes. He won the action in the lower court, but the company took it to the appeal court, afterward the Cour de Cassation. Both courts dismissed the appeal and the company was ordered to pay the plaintiff the three centimes. The cost to the company amounted to 8,250 francs, or $1,650.—Railway and Engineering Review.

The United Steel Company, Canton, Ohio, recently made a heat of about 30 tons of vanadium steel, which is claimed to be the largest heat of this class of steel thus far made.

AN EXHIBITION OF FRUITS AND VEGETABLES IN WAX.

BY CARA REESE.

A scientific classification of fruits and vegetables finds attractive illustration in a series of exhibits of waxen products in the museum department of Carnegie Institute, Pittsburg, Pa., as prepared and arranged by the section of botany of the Institute. The idea of the portrayal of familiar edible growths

Removing the Fruit from the Plaster Mold.

in wax as a museum feature of study is a new one, although one or two agricultural colleges have made small beginnings in this line, and also the Department of Agriculture at Washington has at present under consideration an elaboration of the same method of exhibition and comparison.

The exhibit in Pittsburg includes the fruits proper, such as the apple, peach, pear, plum, and the like; the products known as vegetables; nuts of all kinds; grain crops with the various cereal products and by-products; root crops, plants used in medicine; fiber plants utilized in cordage and textiles; plants cultivated for the edible stems and leaves, such as spices and condiments; also a display of woods. such as dye-woods, sugars, gums, resins, and lumber. The exhibit appeals to scientific and research students, indeed to all classes, including housekeepers, who are not only captivated by the realistic qualities of the artificial products, but instructed as to the manner of growth of certain fruits and the section of country from which many familiar edibles are derived.

The most popular phase of the exhibit, of course, is the method of showing the edible fruits. It is a difficult thing, for instance, to indefinitely preserve perishable fruits in such a manner that they may be used for display purposes in a museum showcase and still retain their natural colors. The usual method is to place the fruits in a weak solution of formaldehyde, alcohol, sulfurous acid, or zinc chloride. But when this is done, the products are distorted by the glass jar filled with liquid, and in time the colors fade. The Carnegie Museum through its capable director, Dr. William J. Holland, when the exhibit of edible products was decided upon, determined to duplicate the natural fruits in wax, and by tinting with permanent paints to reproduce as closely as possible the appearance and color of the real products. A workroom was set aside for the modeling and painting of the fruits with Mr. Otto Emery Jennings, head of the section of botany, in charge. Mr. Jennings was given full authority to make purchase of the natural products wherever they might be found, the world over, and privileged to originate and develop special plans of his own as to the details of the manufacture and display of the artificial duplicates. With Mrs. Jennings as his enthusiastic assistant, he has not only succeeded in laying the foundation for a remarkable exhibit in time of every known specimen of edible growth in the whole vegetable kingdom as illustrative of economic botany, but has already placed on public view an arrangement of products both instructive and picturesque.

The method of manufacture of the waxen fruits in the busy workroom is most interesting. The fruit specimen is indented in sand up to one-half; the exposed half, well greased, is then treated to a heavy coating of plaster of Paris; when this coating dries, the specimen is reversed and the coated half, plaster and all, is thrust into the sand, and the exposed portion of the fruit is greased and coated as at first. When dry the plaster molds are separated and the fruit is gently pried out. The half molds are then tied together, a small opening is made, then a refined beeswax, melted, is poured into the opening and the molds are set aside until the wax hardens. One of the illustrations shows Mrs. Jennings at the modeling table in the act of removing a real fruit specimen from the mold.

The waxen fruits when hardened are painted by the artist, who keeps the real specimen constantly in view, and strives not for mere artistic beauty, but for an exact reproduction of the natural tints and markings. Casts are also made of fruits cut in sections, and the wax is faithfully tinted to show the seeds, the core, the interior color, texture, and the relation of the size and position of the various parts. In one illustration may be seen the fruits whole and in sections on the drying rack after the tinting, and in another is shown the artist at the painting task.

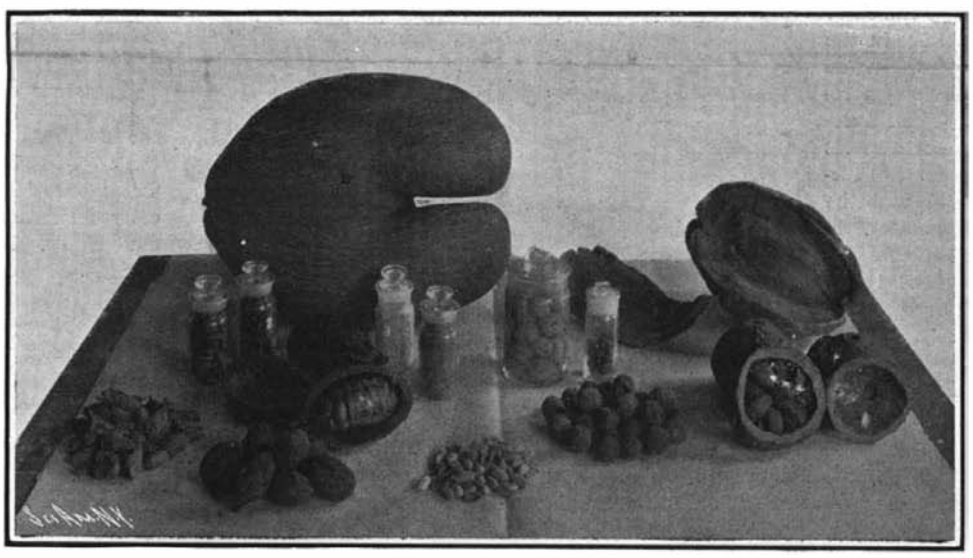
In the fruit specimens already on display are the leading apples of the North, the Baldwin, the Rambo, the Russet, the Greening, and the like down to the pretty little Lady apple, the fancy visitant of the winter in its satiny skin of yellow and crimson; there are the pears with the handsome winter Bartlett in the lead; the peaches, from the common downy variety to the smooth-skinned nectarine; the bananas in the familiar yellow and the plump short Jamaica in its deep, purplish red skin; the pomegranate in its rough orange-like covering; the avocado, the pear-shaped fruit from four to five inches long with skin beautifully mottled in purple and green; then in pleasing array the pineapple, the clusters of grapes, the cherries, the plums, the apricots, the persimmons, the berries, the strawberry, the gooseberry, blackberry, raspberry, currants, and small fruits. Then the citrus fruits, which to many are the most interesting of all on account of their beauty and variety. There is the large citron from Italy, seven inches long, in color and shape resembling an immense lemon and the "peel" of which in the natural product is nearly an inch thick and is used for candied citron and preserves; there is the Florida rough lemon, a hybrid between the citron and the true lemon and often sold in the market for the latter; then the real lemon and the lime, the latter a small round fruit resembling the

Painting a Waxen Cast.

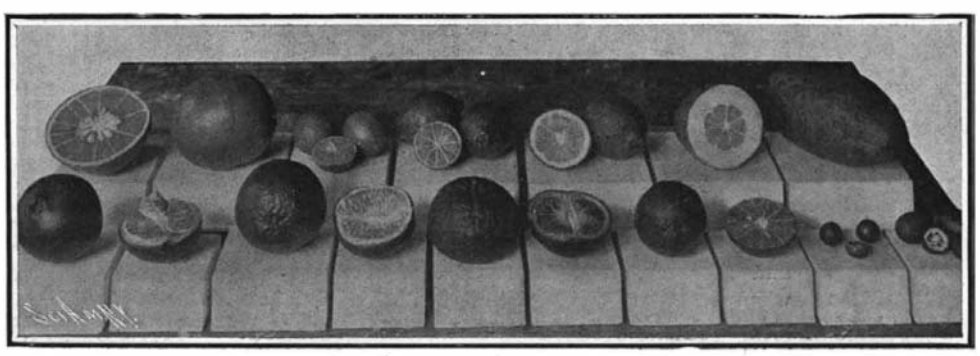
lemon in color, but in nature with a very thin skin and an intensely acid pulp. The grapefruit belongs to this citrus group. This fruit, which takes its name from the habit of some varieties of hanging in grape-like clusters, is shown both in the light yellow-colored pomelo, which is popular as dessert, and in the long pear-shaped forms called shaddocks, a product of the old world. Oranges, which come in the citrus group, are shown in all forms from the King mandarin with its thick russet skin, and the tangerine, a smaller mandarin, through the common or sweet varieties, and the navel orange, to the little kumquats, which are sold in the markets in quart crates like strawberries. The illustration shows a completed citrus group.

The nut group is an interesting one. There are the cocoanut, the English or Persian walnut, the almond, the wild and cultivated chestnuts, the wild and cultivated hazelnuts, the pecans, the black walnut, the white walnut, butternuts, hickory nuts, and on through the list.

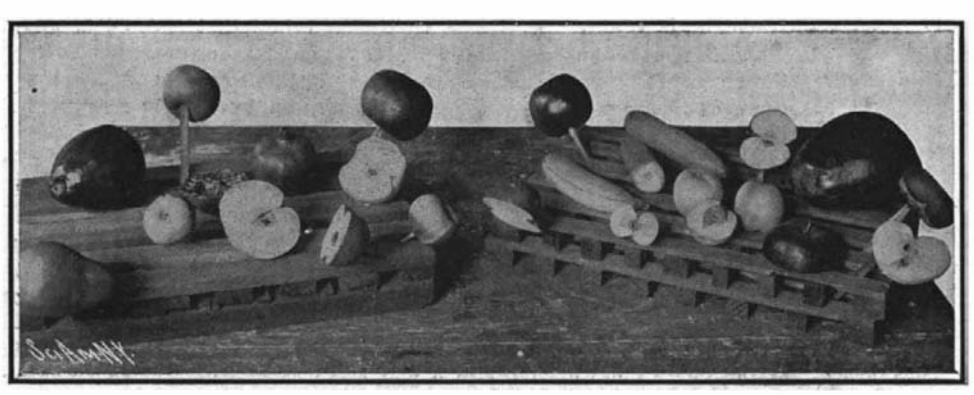
In the illustration is seen the cream nut or Brazil nut in the original shell. The so-called nuts are packed together, twenty-five or fifty of them, in a hard bony shell resembling that of the cocoanut. Around the whole is an outer growth, or shell, similar to that of the black walnut. The pistachio nuts are the small nuts seen in the center of the picture. These nuts are much used in confectionery, and, in Europe, for flavoring meats. The nut is about the size of the meat of the peanut, and is inclosed in a thin hard shell of a light yellow color. The Lychi nut is a Chinese favorite. It is shown directly in front of the two vials of its by-products, namely, preserves and dried fruit. The meats of the nut are canned by the Chinese much as the Americans can peaches. The meat in the raw state has the resemblance and flavor of a raisin. The cocoanut is seen in the picture, also a group of butternuts and filberts. The immense nut in the background is a coco-de-mer, or "a cocoanut which floats on the sea," after tumbling from the trees along the shore. It is captured by natives along the shores of the islands in the south of the East Indies. The meat of the great nut is used for medicines, the shell for the fashioning of utensils, and the outer covering for the thatching of the native huts. In front of this great nut in the picture is shown the cocoa-pod, the fruit of the cacao tree, and not of the cocoanut palm. This is interesting to housekeepers from the fact that it is the shell of this nut which is so frequently ground up and sold as spices in the market on



A Nut Group With By-Products.



The Citrus Group in Wax.



Models on the Drying Rack After Painting.

AN EXHIBITION OF FRUITS AND VEGETABLES.

account of its spicy taste. The shell is from a quarter to half an inch in thickness, and incloses forty or fifty oblong seeds about the size of a lima bean. These seeds broken into small pieces are called cocoa nibs, and from these is obtained cocoa butter. The nibs after this use are then ground into the cocoa which is used as a beverage. When the nibs are ground up without the extraction of the butter, the product therefrom constitutes the common household chocolate. The vials in the picture contain the by-products, that is, seeds, nibs, butter, and cocoa, but, it is needless to say, no adulterated spices.

The exhibit also includes a long list of grains, together with the various flours, meals, and other cereal products. There is the durum, or macaroni wheat, a hard wheat much grown in Russia and Algeria and now beginning to be cultivated in our Northwest and from which the semolina or flour is made, and from this in turn the macaroni, spaghetti, and noodles. There are the fibers, also the flax before retting, the tow or raw fiber, the cords and threads of various grades and sizes; and the cotton, raw cotton; cotton from scutching; cotton from cards; also specimens showing the various processes up to the finished yarns and fabrics. Then the fibers of the jute, the hemp, the sisal, and the "new linen plant," a Brazilian plant nearly related to cotton, are represented in all raw and partially prepared and finished states.

The medicine roots, stems, and leaves are an interesting class in themselves. There are the specimens of castor bean, the sassafras roots, the slippery elm, flaxseed, sweetflag, burdock, boneset, mustard, aloes, foxglove, golden seal, licorice, ginger, quinine, witch hazel, and on through an exhaustive and instructive list.

Seux's Aeroplane.

Among the new aeroplanes which are being tried in France is a flyer designed by M. Edmond Seux, secretary of the aviation section of the Aero Club of the Rhone. After making a theoretical study of the problem, he constructed a flyer which embodies some of the principles of a bird's flight. Curved surfaces somewhat resembling a bird's wing are used here, and to carry out this idea the front part of the curved surface is made thicker. Mr. Seux claims that this arrangement adds greatly to the stability and makes it possible to attack the air at a small angle of two or three degrees. The sides of the wings can be raised or lowered by means of springs, and the stability in the longitudinal direction is given by two rudders. In the front is a rudder which can be operated by the aeronaut at the start, but afterward it is to work automatically. The rear rudder is quite automatic in its action, and is held by a spring. The total carrying surface is 24 square meters (259 square feet) and the apparatus weighs 470 kilogrammes (1,034 pounds). It is equipped with a 35-horse-power motor of the Anzani pattern. As to the helices, there are two of these, mounted one on each side of the central framework. It is claimed that this disposition, which is used in the Lebaudy airship, has the advantage of working the propellers upon air which is not disturbed by the movement of the apparatus, and it gives a better balance with an increased yield from the propellers. Following the above-mentioned principle, the propellers, which have two blades, are thickened on the front edge of the frames or the part which cuts the air. The framework is made to run upon the ground upon four wheels, and is built of steel tubes. After the preliminary trials, which proved the apparatus to be in good order, an attempt was made to fly in the air, but this was not successful owing to several difficulties which can no doubt easily be overcome. It was run at a speed of 20 miles an hour with the front part somewhat raised, but the angle was no doubt too great, which caused the flyer to tilt backward, making the propeller touch the ground and breaking it. The result showed that the rear wheels are too low and not strong enough, and that the flyer is to be directed in the air at a very small angle. But in order to do this the speed must be increased, and a heavier motor will be needed, or a lightening of the load. On the other hand, it is noticed that the stability in the lateral sense is very good, and this has been a difficult point to obtain up to the present.

Weeds of Great Value.

New Zealand flax is one of a number of wild weeds that yield their gatherers great wealth. This flax, the strongest known, grows wild in marshes. When it is cultivated it dwindles and its fibers become brittle and valueless.

Indian hemp grows wild, and out of it hasheesh, or keef, is made. Keef looks like flakes of chopped straw, It is smoked in a pipe; it is eaten on liver; it is drunk in water. It produces an intense, a delirious happiness; and among Orientals it is almost as highly prized as beer and whisky with us.

The best nutmegs are the wild ones. They grow throughout the Malay Archipelago.

But the most valuable weed of all these wild growths is the seaweed. The nitrate beds of South America, which yield something like $65,000,000 a year, are nothing but beds of seaweed decomposed.

THE MOON'S PHASES AND ECLIPSE IN JULY, 1907.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

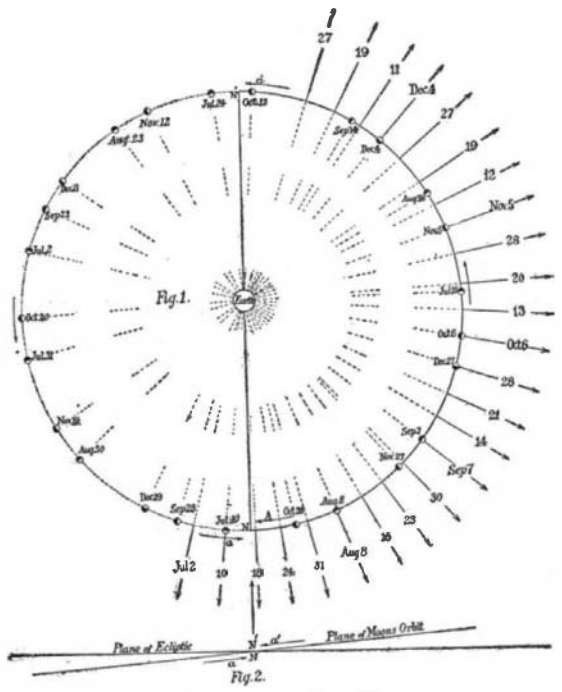
The moon's orbit is one of the most interesting studies in astronomy, because of the varying positions of our satellite relative to the sun and earth, and the fact that it is larger than any other satellite in our system in proportion to its primary.

Twice in every month the earth and the moon exchange places relative to the sun, whose attraction, combined with that exerted by each body upon the other, results in a modification of the form of the moon's orbit, which is an ellipse whose plane is inclined at an angle of a little over five degrees to that of the ecliptic.

This plane slowly changes its position as indicated by the line of nodes, which is its intersection with the plane of the ecliptic. The position of this line for each year for nineteen years was indicated in a recent article by the writer. (See "The Eclipse of the Sun in 1907," SCIENTIFIC AMERICAN for May 25).

The eccentricity of the moon's orbit is on the average a little more than one-twentieth; but it varies between wide limits, bringing our satellite sometimes thirty-one thousand miles nearer the earth than the maximum distance. It should also be noted that the moon's perigee is continually changing its position, making a complete revolution in about nine years.

The plot of the orbit (Fig. 1) must therefore be



THE PLOT OF THE MOON'S ORBIT.

regarded only as an approximation, which on a small scale is sufficiently accurate for the present purpose, which is to exhibit the phases of the moon for the latter half of this year, and the conditions which will result in the eclipse of July 24. The direction of the moon's motion is shown by the arrows marked *a;* while the arrow *A* indicates the direction of motion of the ascending node that is opposite to that of the moon, which results each year in advancing the dates of the eclipse seasons.

In treating the eclipse of the sun in 1907, the edge view of the plane of the ecliptic and of the moon's orbit was drawn as if seen from the earth. Fig. 2 on this page is a view from the opposite direction, and one which includes both the ascending and descending nodes. Thus the arrow *a* in Fig. 2 corresponds with *a* in Fig. 1, showing the path of the moon when she is approaching the ascending node *N* on the side nearer the observer; while the arrows marked *a'* in Figs. 1 and 2 indicate the direction of the moon's motion when she is approaching the descending node *N'* on the side farthest from the observer.

Regarding the plane of the ecliptic as horizontal and in the plane of this page, that part of the moon's orbit which is above the plane of the ecliptic is represented by the full line, and that part below that plane is shown by the dotted line. The positions of the moon are shown for the dates attached, which are those of the four quarters for the last six months of this year. The dates are given in the accompanying table.

Since the distance between the sun and the earth is on the average three hundred and eighty-nine times the distance between the earth and the moon, it is impossible to include the sun and the orbit of the earth in a plot whose scale is large enough to illustrate the moon's orbit. In Fig. 1 the diameters of the earth and moon are enlarged, in order to make the phases of the latter more apparent in a plot of these dimensions. The earth is here regarded as stationary, and the varying positions of the sun relative to the earth at the dates attached are shown by the arrows, which indicate the direction in which it is seen; i. e., Fig. 1 shows the longitudes of the sun and of the moon at those dates.

On July 24 the moon will be at perigee. On that day she will pass the descending node *N'*; but the sun, the earth, and the moon will not be in the same straight line. Later in the same day, when the moon will have passed below the plane of the ecliptic, the eclipse will occur. The result will be a partial eclipse visible at Washington and North America generally, excepting the Northwest.

The following "times of the phases" are from the Nautical Almanack:

	d.	h.	m.	
Moon enters penumbra	July 24	13	58.7	Greenwich mean time
Moon enters shadow	"	15	3.7	
Middle of the eclipse	"	16	22.4	
Moon leaves shadow	"	17	41.1	
Moon leaves penumbra	"	18	46.2	

	July	Aug.	Sept.	Oct.	Nov.	Dec.
New Moon	10.14	8.77	7.38	6 93	5.44	4 93
First Quarter	18.05	16.38	14.65	13.92	12.22	11.60
Full Moon	24. 9	23.01	21.40	20.89	19.50	19.25
Last Quarter	31.60	30.23	28.98	28.83	27.68	27.47

Grammar of the Indian Languages.

Prof. A. L. Kroeber, of the University of California, declares that Indian languages are not a jargon, as is popularly believed. In a pamphlet recently issued on the Yukuts and Yuki languages he affirms that Indian languages possess an elaborate and difficult grammar, though this is unknown to the Indians themselves, and must be extracted by the investigations of scientists. The two languages which Prof. Kroeber selected for experiments had absolutely no similar words. They are more different than English and Russian. The Yukuts and the Yuki are not even in territorial contact, and show no signs of common origin. The Yuki live in northern California in the Coast Range, and the Yukuts are located in the interior of south central California in the southern end of the San Joaquin Valley. Though Prof. Kroeber found that the grammatical structure of their languages was identical at nearly every point, the words were wholly dissimilar. The two languages are like houses on the same plan, but of different material.

The sentence structure employed in the two languages is full of interest. The order of words differs quite thoroughly. In Yukuts the adjective precedes the noun, in Yuki it follows. Yukuts tend to place the verb at the head of the sentence, Yuki at the end. The numerical systems of the two languages are radically different. That of Yukuts is decimal, of Yuki quaternary. It is noted by Dr. Kroeber that California has more totally distinct Indian languages per square mile than any other State. The reason for this great variety of languages has never been properly accounted for.

The Fiala Trip to the North Pole.

Capt. George Comer, of East Haddam, Conn., who is to command the Fiala expedition in search of the North Pole, sailed from New London in the 58-ton vessel "E. T. Gifford" to establish bases of supply for the main expedition, which will set out several months later. The "Gifford" will shape its course toward Cape Fullerton, Hudson Bay, and will then proceed further north.

Figures compiled at the request of E. H. Harriman show the extent to which Pacific coast shippers have been delaying the unloading of freight cars. The records of the principal California and Oregon shipping centers show that since April 1 an average of 3,632 cars per day were held overtime for unloading on the Harriman lines in this territory. From that date to May 1 conditions grew worse, but the June records show considerable improvement owing to the railroad's insistence that cars be released. Portland shippers on April 1 were holding 674 cars, which they had increased to 823 on May 1, and reduced to 216 by June 11. San Francisco, which had 1,860 cars tied up on April 1, was holding 2,358 May 1, and 1,640 June 12. Oakland's record was 494 for April 1, 429 for May 1, and 365 the middle of this month. Sacramento and Los Angeles shippers are holding 150 more cars now than on May 1. The average number of cars so withheld from service aggregate over twenty per cent of the total new equipment bought by the Union Pacific and Southern Pacific for delivery up to July 1. This new equipment amounts to 8,000 cars for the latter system and 7,000 for the Union Pacific lines.—Railway and Engineering Review.

Modeling Wax.—White wax 50 parts, turpentine 15 parts, cinnabar 10 parts, glycerine 5 parts, to be melted and stirred.

Correspondence.

A Method of Cleaning Silver.

To the Editor of the SCIENTIFIC AMERICAN:

Having read the article on "Method of Cleaning Silver," published in the issue of May 25, I would suggest that a very similar method has been frequently used by friends of mine, with the exception that they use sour milk. The milk which sours during the week is kept until Saturday morning, when it is poured into a large tin dishpan and the silver placed in it, so that the milk entirely covers the silver. The silver is left in this way for from fifteen minutes to half an hour, depending entirely on the amount of sediment or dirt on the silver. After the silver is clean, all that is necessary is to rinse it in hot water and rub dry. The sour milk does not act in anything but a tin vessel.

Valley Park, Mo. W. O. R.

A Wireless Interpretation of Ball Lightning.

To the Editor of the SCIENTIFIC AMERICAN:

In Prof. John Trowbridge's article on "Ball Lightning," published in the SCIENTIFIC AMERICAN of June 15, he points out that a great quantity of electricity is manifest in the phenomena of ball lightning. I believe, that in most cases, when the discharge comes to the earth, there is a great quantity of electricity manifest. The discharge breaks down the resistance of the lower atmosphere, thereby opening a path for the rush of a great quantity of positive electricity from the upper atmosphere or higher altitudes to the earth—a "coherer effect" on a grand scale.

I know of an instance where a thriving locust tree was struck by lightning and burned almost to the ground. There certainly was a great quantity of electricity manifest in that discharge.

Carlisle, Pa., June 29, 1907. J. HOLMES WILSON.

Fire in Ships and Its Prevention.

To the Editor of the SCIENTIFIC AMERICAN:

In supplement to the communication I addressed to you some time ago, and which was published in your number of the 8th of June, upon the subject of the salvage of vessels, I desire to direct attention to another danger that is imminent in all vessels, and perhaps the worst danger of all, namely, that of fire.

There are a good many chances in favor of a person being saved in the case of a collision or a shipwreck; but should a fire take place on a vessel 1,000 miles from land, which could not be overcome, and no other vessel happened to be in the vicinity, the chance is reduced to a minimum. Happily, there have not been any very serious results from accidents of this nature within recent years. The case of the Inman steamship "City of Boston," which was lost, I think, in 1873, and which has never been accounted for, might possibly have arisen from fire.

However, the question that I propose to deal with is the prevention of fires at sea.

Most people are familiar with the effect of carbonic acid gas on fire, and how quickly a fire can be extinguished by its use. There are many ways in which a fire may occur on a ship—spontaneous combustion in coal bunkers or in cargoes of sugar, hay, wheat, or grain of any kind, or by a lighted match being thrown among inflammable material by a careless smoker; breakage of packages containing chemicals, lucifer matches, etc.

I maintain, therefore, that every ship should be equipped with complete appliances for the generation of carbonic acid gas, with a system of piping that would reach every compartment in it, either collectively or separately. The generating apparatus itself to be placed in a fireproof room accessible only from the hurricane or weather deck of the vessel. As this gas is much denser than atmospheric air, it would be well that these pipes should be laid to points in the bottom of the hold near the keel; the air could thus be more effectively driven out through an escape or relief pipe, in the case of a closed compartment. No fire can exist for a moment in an atmosphere of this gas, and no damage of any kind could result to a cargo by its use. There is no place where a fire could be so successfully fought by these means as on a vessel of any description that has closed decks. When a fire has been extinguished, the gas could be exhausted from the hold by the same pipes. In the case of oil-tank vessels, or vessels of any kind carrying explosives, such as battleships, etc., where the compartments in which these materials are stored are airtight, it might be well to keep these filled with carbonic acid gas, as, being so much heavier than air, it would remain there indefinitely, and thus render a fire or explosion impossible.

The elements required for the generation of this gas—sulphuric acid and iron filings—are so inexpensive that no vessel should be without a complete equipment such as I have described. It would always be ready for action, and is infallible if supplied in sufficient quantities. The cost of piping even a very large vessel would be trifling compared with any efficient system of fire engines and hose, and the gas would reach points in a vessel that it might be impossible to get at by means of a water system, and without flooding the ship's hold and thereby creating the danger of foundering.

This, perhaps, might be a useful equipment to install in the fire-fighting vessels in the harbor of New York, to be used, of course, only in cases where no human beings are accidentally imprisoned in the hold of a vessel, such as that which occurred in the case of a Hamburg-American steamship at Hoboken about two years ago.

I submit these suggestions for the consideration of ship-builders and shipowners, and I think that such a system combined with the one I referred to in my previous communication would render a vessel pretty safe under almost any contingency that might arise.

Ottawa, Canada, June 17, 1907. J. E. W. CURRIER.

The Fourth Annual Automobile Touring Contest for the Glidden Trophy.

On Wednesday, July 10, by the starting of 74 automobiles from the city of Cleveland, Ohio, the fourth annual touring competition of the American Automobile Association for the Glidden trophy was inaugurated. These machines are carrying nearly 300 passengers on a 1,570-mile journey through the several States in the central section of our country, at an average speed of about 18 miles an hour. The tour will consist of twelve daily runs averaging 130 miles in length, the longest day's run being 174.2 miles and the shortest 97.2 miles. The route extends from Cleveland to Chicago, *via* Toledo and South Bend; thence to Pittsburg *via* South Bend, Indianapolis, Columbus, and Canton, Ohio. From Pittsburg the tourists will return to New York city *via* Bedford Springs, Baltimore, and Philadelphia. The roads, as a rule, are ordinary country turnpikes, which, however, are likely to become heavy and slippery in case there is much rain. Owing to such conditions on the second day, the tourists found it very difficult to keep their cars from skidding in the run from Toledo, Ohio, to South Bend, Ind., and while attempting to pass a four-cylinder Pierce car, one gentleman, who was driving a six-cylinder machine of the same make, had his machine skid off the road and overturn. As a result of this accident, the driver and a lady passenger were severely injured from being pinned under the car. A similar mishap occurred to a Packard machine, which skidded while rounding a sharp curve and turned upside down. The owner and driver of this car was also badly cut and injured about his chest. As a result of these accidents, the tourists are using great caution and are hoping that the skies will remain clear. In the section from Pittsburg to Bedford Springs there are many water breaks across the road at frequent intervals, and some tourists who recently went over the course in a Peerless car report that a speed of more than 10 miles an hour will not be possible. Some contestants have threatened to abandon the tour if the officials do not make a slower schedule where bad roads are encountered.

This year the Glidden trophy for touring cars carrying four passengers will be awarded to a club, instead of to any one car; but the score of each car will be recorded daily and at the end of the tour each contestant will receive a certificate as to the performance of his car. Another trophy known as the Hower trophy has been offered by Mr. Frank D. Hower for the runabout which has the most points to its credit at the finish. All the cars are credited with 1,000 points apiece at the start. They are penalized 1 point per minute or fraction thereof in excess of two minutes which they are late at controls, and 1 point per dollar or fraction thereof of the value of parts which have to be renewed. Any car which drops out for any reason will be penalized the full 1,000 points in addition to any penalizations it may already have. If there are three or more cars in any one team, and one of these cars loses a number of points, the team will not lose the entire number of points, but merely this number divided by the number of cars that make up the team. Thus if one car of a three-machine team loses 12 points, the team will lose only 4.

The rules governing the tour this year are very strict. They require that the cars must at all times be fully equipped with mufflers, mud guards, etc., and that they shall carry four passengers of an average weight of 125 pounds, or the equivalent in ballast. No replacements, replenishments, adjustments, repairs, or inspection can be made on any car after it has been registered at a night control and before it is started the next morning. No replacements can be made with parts not inventoried and carried at the start. Each car can carry but one mechanic, and no one else save the operator of the machine is allowed to make repairs. There are no official observers, but at the end of each day's run the driver must make a statement as to the repairs and adjustments made during the day, and this statement must be attested by each occupant of the car. A pacemaker is provided and the cars are obliged to maintain a uniform speed as nearly as possible. They are given a certain time to make the run each day, and there is but one control provided, which is at the end of the day's run.

Altogether, fifty-nine machines started in the competition for the Glidden and Hower trophies. Forty-six of these machines are touring cars, competing for the former, and thirteen of them are runabouts competing for the latter trophy. There are about 35 different makes of cars on the run. A partial list of these in alphabetical order follows: One Acme, one American Mors, two Aerocars, one Autocar, Apperson, Berliet, Cleveland, Columbia, Continental, Deere, three Dragons, one Gaeth, three Haynes, one Lozier, a Matheson, Mitchell, Meteor, Marion, three Maxwells, one Oldsmobile, seven Pierces, three Packards, two Premiers, two Peerlesses, one Pungs-Finch, one Pennsylvania, three Reos, one Ranier, two Royals, one Shoemaker, two Stoddard-Daytons, six Thomases, one Walter, two Welches, and two Whites.

Of the 46 Glidden contestants, 10 represent the New York Motor Club, while the remainder are divided between the automobile clubs as follows: Automobile Club of America, 4; Westchester, 3; Buffalo, 5; Cleveland, 9; Chicago, 7; Detroit, 4, and Pittsburg, 4. Owing to the overturning of two cars on the second day and the withdrawal of two others at the end of the third day at Chicago, as well as to the dropping out of several more from various causes, at the completion of one-quarter of the tour but two of the contesting clubs—the Buffalo and the Pittsburg—had perfect scores. Some of the other clubs were penalized as follows: Automobile Club of America, 253¾; New York Motor Club, 131-5; Chicago, 343; Detroit, 304. The Westchester Club was also heavily penalized owing to the dropping out of a Maxwell car and the breakdown of several other cars.

After a two days' rest in Chicago the tourists resumed their journey on Monday, the 15th instant, with the expectation of reaching Pittsburg on Friday evening and Bedford Springs, Pa., the following night. Sunday, the 21st instant, will be spent there, and during the following three days they will tour to Baltimore, Philadelphia, and New York. Notable features of the present tour are the complete absence of foreign cars and also of air-cooled machines. A considerable number of new American makes of cars are receiving their initial public testing, and some of the cars (the 40 H. P. Berliet and the 30 H. P. Haynes are attempting to make the entire trip with sealed bonnets.

The Daniel Comet.

A new comet was discovered by Mr. Daniel at Princeton Observatory on June 9 and confirmed by Prof. W. R. Brooks on June 11 at Smith Observatory. It promises to be an interesting object, and is now quite rapidly increasing in brightness. An observation made on the morning of July 8 showed it to be three times brighter than at discovery. Its position was right ascension 1h. 29m. 50s.; declination north 7 deg. 0 m. This places it on the foreleg of Aries, from which place the comet is moving in a northeasterly course. On August 1 it will be in the head of Taurus, and from these two positions the course of the comet for the present can be easily marked out. The comet is now visible in a small telescope or field glass, and will soon be visible to the naked eye in the eastern morning sky.

On July 10, at 2 o'clock, the sky being very clear, the comet was detected with the naked eye as a misty star of the fifth magnitude. A tail one and a half degrees in length was easily seen in the 10-inch telescope. The tail was also visible in the 3-inch finder.

The Current Supplement.

The amateur experimenter will learn much from A. Frederick Collins's article on "How to Construct a Simple Wireless Telephone," which is published in the current SUPPLEMENT, No. 1646. Mr. Collins describes fully and accurately how a wireless telephone working on the principle of electro-magnetic induction can be made at home. Ernest Schneider contributes an instructive article on the autogenous welding of metals. The great work of building the Parisian underground roads is described and illustrated. Alfred Sang's interesting paper on the art of galvanizing is concluded. The wonders of the town of Knossos are picturesquely set forth in an article on the excavations in Crete, which is accompanied with excellent photographs. The chemistry of dynamite is examined in detail. The naval tactician will find of no little interest a paper on gun distribution aboard modern battleships.

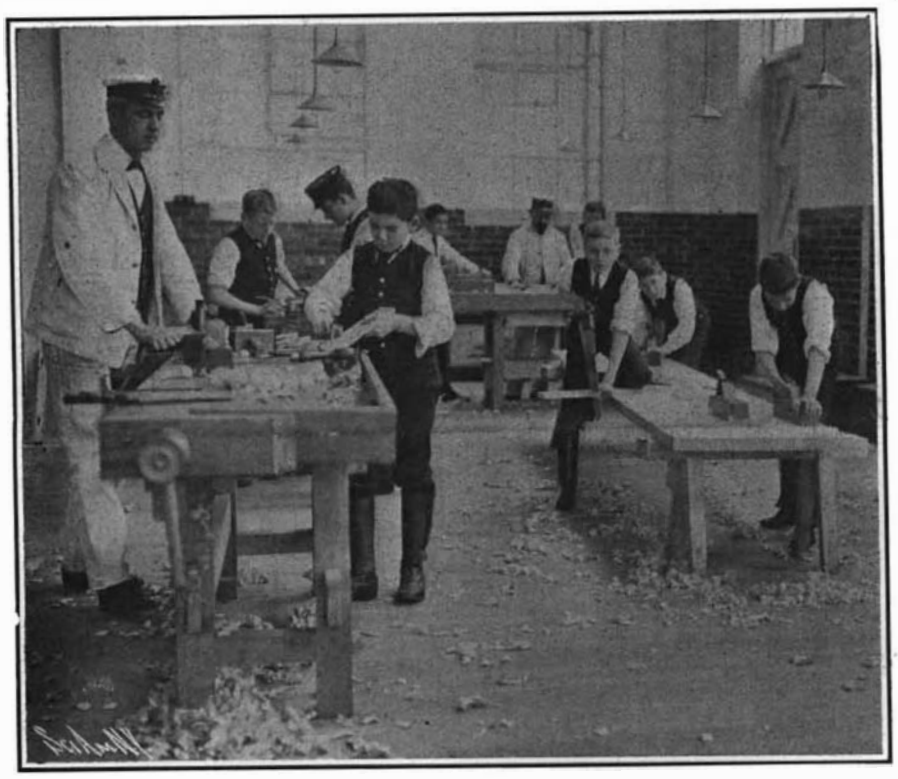
The Krupp establishments employ at present some 53,000 workmen and 5,000 engineers and officials. Of this total of 58,000 persons, 40,000 persons are employed at the steel works and coal mines at Essen, 4,000 in the iron mines, 4,000 at Rheinhausen, 4,000 at Magdeburg, 5,000 at the Germania shipyard at Kiel, and 1,000 at the steel works at Armen. Among the leading specialties of the firm are guns, armor plates, rifles, shells, boilers, rails, axles, tires, propellers, tubes, etc. —Mechanical World.

OSBORNE COLLEGE: AN ENGLISH NAVAL SCHOOL.

BY HENRY HALE.

The British methods of recruiting and educating young men who are to officer the ships of the several fleets is quite different from the American method. While in the United States the education of the naval officer is centralized, so to speak, at Annapolis, one finds institutions for the training of cadets at different points in Great Britain, as well as several station ships which are intended exclusively for instruction of this sort. The boy who enters the Naval Academy at Annapolis not only secures a knowledge of the ordi-

The Cadets of Osborne College.



A Lesson in Carpentry.

The Chemical Laboratory at Osborne College.

The Parade Ground of Osborne College.

OSBORNE COLLEGE: AN ENGLISH NAVAL SCHOOL.

nary duties of a sailor and ship's officer, but also receives a thorough military training as well, being required to handle field artillery; in fact, becoming proficient in all of the branches of the land service with the exception of the cavalry. It may be needless to say that the present routine at the Academy includes his instruction not only in navigation and other branches of seamanship, but before making his first cruise on any of the practice vessels he has become versed in naval construction as well as steam engineering.

The British midshipman, however, usually enters one of two courses, which fit him for an engineer officer or an executive officer, the older cadets being divided into these two classes, and following the system which prevailed until recently in the United States navy. The cadets intended for executive officers secure entrance usually through the Admiralty Office, those who pass the examination go to the new college, also the ship situated at Dartmouth. Their studies are quite similar to the curriculum at Annapolis, the life on shipboard being relieved by short practice cruises both in steamers and sailing vessels. At the end of fifteen months they are supposed to graduate as sea-going cadets, and are then assigned to warships, to serve three and one-half years as acting sub-lieutenants. A course of six months at Greenwich is supposed to complete their education, with the exception of instruction in ordnance. They then receive their commissions as sub-lieutenants, and become naval officers in reality. The cadet engineers, however, receive most of their instruction at Keyham in Devonport, where they remain about four years before going to sea.

One of the most interesting institutions connected with the British service, however, is what is known as Osborne College, where boys are trained for various positions in the navy, special attention being given to technical branches. As the name indicates, the college is located on the Isle of Wight not far from the famous Osborne House, which was the summer residence of Queen Victoria for so many years. The institution is admirably situated for the purpose intended, being but a short distance from the sea, with grounds ample for the various drills as well as for the dormitories, instruction halls, and other necessary buildings. The students of Osborne College are obliged to enter between the ages of twelve and thirteen years, none being taken who are older than the age specified. They are instructed according to the new system adopted by the Admiralty Office in 1902, and are recruited largely from the sons of commissioned officers at present in the navy or retired. It may be said that as much care is taken in selecting students for Osborne as for the other service schools. The course of study here embraces not only the ordinary English branches pursued by boys of this age, but an elaborate system of physical culture, in which calisthenics and other evolutions enter. The first classes are taught the use of the pistol and other small arms, while the more advanced classes drill with various types of marine ordnance, from the rapid-fire gun mounted in the military top to the smaller pieces comprising the main battery.

The length of the course at Osborne College is four years, and in addition to the instruction referred to, the students are given lessons in the use of hand tools, both for wood and metal working, as well as power machinery of various sorts. Of course, a requisite is seamanship, especially the handling of sails and yards, the splicing and knotting of ropes, and other work which pertains to the sailing vessel exclusively. Thus the classes who graduate from Osborne College secure not only a knowledge of mechanics and engineering, but the construction and equipment of the sailing vessel, whether it be a full-rigged ship or a one-masted sloop.

Osborne College is one of the latest institutions for naval instruction. It may be termed a preliminary school, since the majority of those who graduate from it enter the higher institutions to complete their education, whether intended for engineers or for executive officers. As a preparatory school the college has already proved itself a most valuable addition to the system provided by the government to equip officers for its navy.

Increasing the Efficiency of Boilers.

Experiments now being conducted by the boiler division of the United States Geological Survey fuel-testing plant at St. Louis, Mo., on the nature of boiler efficiencies have suggested that stationary boilers ought to be made to do ten to twenty times as much work per unit of heating surface as they do now.

This great increase in capacity is to be attained by subdividing the heating surface and water streams more finely, by allowing less restriction of the water inside the boilers, and by using high forced and induced draft to put a large mass of gases through the boiler at a very high speed.

Up to the present time there have been only vague ideas among engineers as to what factors influenced the efficiency of the steam boiler portion of the steam generator apparatus, so as to cause it to absorb more or less of the heat generated by the combustion. Mr. John Perry, a distinguished mechanical and electrical engineer of England, went into the subject mathematically a few years ago, and set forth general conclusions tentatively in his book on the "Steam Engine and Gas and Oil Engines."

About a year ago, the government testing plant took up the mathematical investigation of the theory of the steam boiler and of heat absorption, and extended Mr. Perry's theory somewhat. For some weeks past Mr. Walter T. Ray, assistant engineer, acting under the supervision of Prof. L. P. Breckenridge, engineer in charge of the boiler division, has been conducting a series of experiments on small multitubular boilers, dimensioned as to enable the theory to be verified, or modified, or refuted. The boilers are fed with air heated electrically. Mr. Perry's theory states that modifying conditions being omitted from consideration, every boiler will always absorb by convection, from the gases passing through it, the same percentage of heat which could possibly be absorbed by any boiler containing water at a given steam temperature. This efficiency is, therefore, independent of the temperature of the entering gases and of the amount of gases flowing through the boiler. Of course, it must be understood that the above statement of the theory is slightly subject to modification even theoretically, and more so in practice.

As a practical example, assume that the water in a boiler circulates with entire freedom, which is an unwarranted assumption, and that its temperature is 300 deg. F.; let the gases enter the boiler at 1,300 deg. F.; then the difference between the two is 1,000 deg. F., and consequently it would be possible for a boiler infinitely long to reduce the temperature of the gases passing through it to 300 deg. F. Let us assume, however, that the gases leave the boiler at 500 deg. F., which is 200 deg. above steam temperature. The efficiency of the boiler then is 80 per cent, because it has reduced the temperature 800 deg. out of a possible reduction of 1,000 deg.

If the same boiler be supplied with gases at 2,300 deg. F., the gases enter the boiler at 2,000 deg. F. above steam temperature. Mr. Perry's theory states that this particular boiler will reduce these gases 80 per cent as much in temperature as would a boiler infinitely long; that is, to 400 deg. above steam temperature, which is 20 per cent of 2,000 deg., or to 700 deg. F. It will be noticed that the mass of gases does not enter into consideration at all.

This surprising deduction is being accurately verified by the afore-mentioned division of the Survey, from which it is found, when keeping other conditions the same and when keeping the initial temperature of the gases constant, that the final temperature of the air remains the same, whatever the amount of air sent through the boiler per second. So far, the upper limit has not been reached with tubes clean inside and out, although the rate of evaporation has already been pushed up to many times that obtained even in locomotive practice.

Perry's theory takes into consideration four fundamental features affecting heat absorption at any point of the heating surface:

First: Temperature difference between the gases outside any portion of the boiler tube and the water inside.

Second: The number of molecules per cubic inch in the gases outside the boiler tube.

Third: The specific heat of the gases at constant pressure.

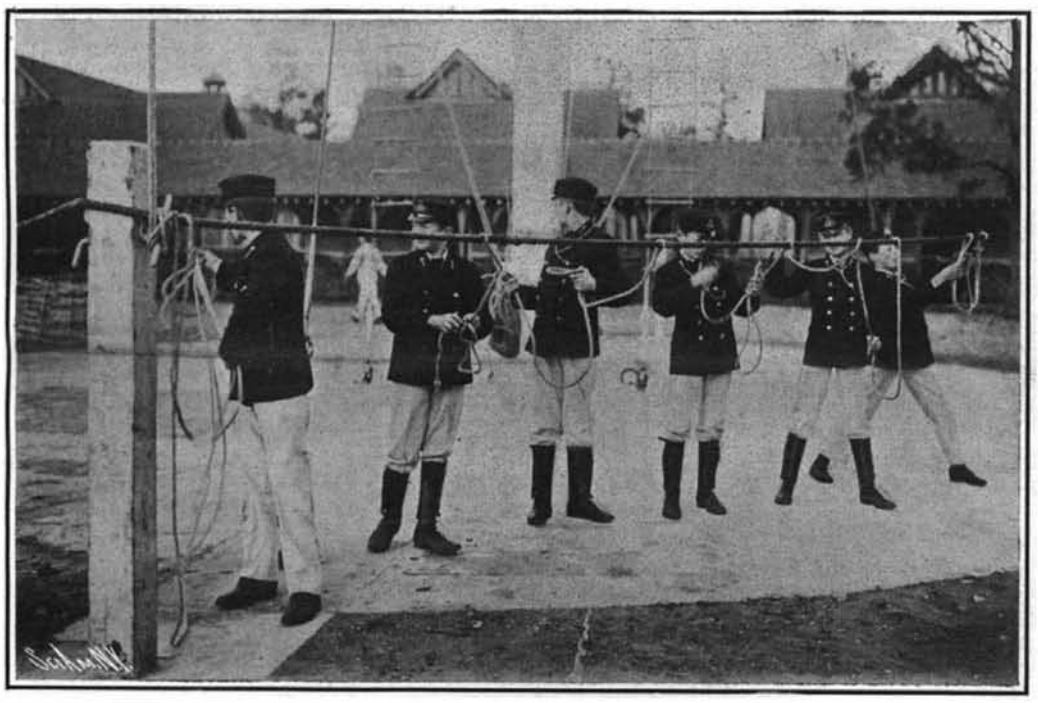
Fourth: The velocity of the gases parallel to the heating surface.

Of the four above factors, only the first has usually been considered. It will be readily seen that if we increase the temperature of the gases, we decrease the number of molecules beating against any square inch of tube heating surface, and thus the second factor largely neutralizes the first, especially at high furnace temperatures.

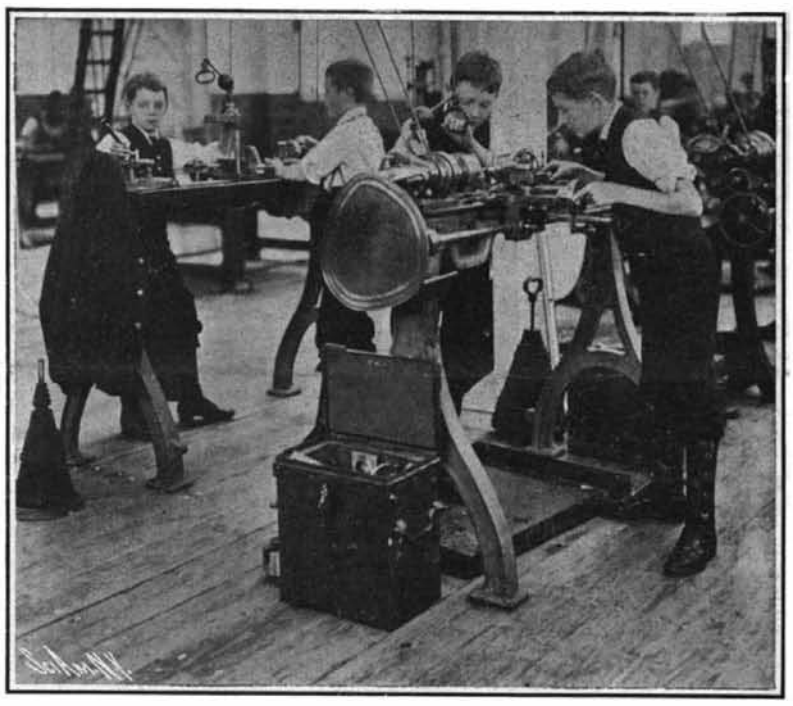
The third factor can be taken as constant, equal to 0.24.

The fourth factor is the new and surprising one. Mr. Perry considers that a high velocity of gases parallel to the heating surface scrubs off more or less of the dense film of gases adhering to the metal surface, which film of gases has already become cold by proximity to the metal. The higher the velocity of gases the more the scrubbing effect, and consequently the greater the amount of heat transmitted. This theory necessarily assumes that the ability of the metal to transmit heat is practically infinite; and when we consider that we ordinarily never put through a boiler tube more than 1/1000 of the heat that it could possibly carry, it will be realized that this assumption is warranted.

Mr. Perry's theory and the Survey's verification of it will result in placing the steam boiler on a fairly secure mathematical basis, the same as generators and motors are now on. Thus far the experiments check the theory excellently. The theory and results will be embodied in a special bulletin to be published soon, to be followed by later bulletins as the work proceeds.



A Lesson in Rope Splicing.



In the Machine Shop.

OSBORNE COLLEGE: AN ENGLISH NAVAL SCHOOL.

A NEW IDENTIFICATION SYSTEM IN THE UNITED STATES ARMY.

BY H. L. MORGAN.

The new identification system in use at present in the army of the United States absolutely prevents any fraud being perpetrated by a soldier upon the government, in the way of desertion and re-enlistment, or in any way which depends upon lack of recognition for its success. The system comprises, first, an accurate personal description; second, a set of finger prints of the most elaborate character; and third, a double photograph of the face and head, from both front and side positions.

The obtaining of all this record, of the thousands of soldiers scattered over the country and its possessions, and in any of one hundred and fifty-eight military posts, is, as may be imagined, a matter of some difficulty. The finger prints did not cause so much trouble, inasmuch as the apparatus is simple, can be used by anyone with a moderate degree of intelligence, and produces results of one sort or another on the instant.

The photographs, however, probably the most important part of the record, were a problem. To send a corps of photographers traveling over the globe to obtain these photographs would not only cause an enormous expense at the start, but would not provide for photographs of further enlistments. The enlistment of a photographer at every post was also open to objections of expense and expediency. So it was determined to provide a photographer at every post, out of hand. As it was not possible to be certain of educating enough men in a short time up to the standard required of an intelligent photographer, photography was simplified to the point where failure is almost impossible, and common sense is sufficient to run the apparatus.

The requirements of the photographs are that they shall be two in number, a front and a side face, that both negatives be on one piece of film, for accuracy and lack of possibility of loss, that they be sharp and clear, that they be uniform, and that they be like one another as to size, shape, and appearance. The War Department, after long and exhaustive investigations and experiments, carried on by Major Edgar Russel of the Signal Office, ordered from a prominent firm of camera manufacturers a quantity of cameras of peculiar design. The lenses have but one diaphragm. The relation of the lens to the plate is fixed—no focusing is possible. The cameras are double, like a stereoscopic camera, but have only the one lens, which, however, is on a laterally sliding lens board, so that it may be placed in front of either camera.

The camera, in use, is fastened to the floor in a fixed position pointing toward a background. In front of the background, in a chair also fixed to the floor, the subject is required to sit. His face, when leaning back in the chair, is fifty-four inches from the lens. This is the arbitrary distance required to bring into focus on the plate an image one-seventh the size of the original. At one side and slightly in front is a white cloth reflector. At the other side is a flash light of peculiar and interesting construction, to be described in a moment. An instant's thought will show that, if the plates and resulting prints are to be uniform, the light must be uniform. Consequently, daylight with its uncertainties is prohibited. The use of the flash light, also, allows the proper exposure to be determined in the home experimental studio, a certain amount of flash powder, in a certain style of instrument, giving a certain amount of illumination on a subject a certain distance from the flash and from the camera. The flash light is a square pyramidal box, open at the end, and covered there with light cheesecloth. The flash cartridge is provided with a thin paper end. This is so placed in the light chamber that the pressing of a button below causes a stream of sparks from two terminals to spring across the paper end. The sparks are from dry batteries and a coil which is part of the outfit. These sparks burn through the paper and ignite the powder which causes the flash. The smoke of the flash is retained in the box. The pictures are made upon films, in a film pack. One picture having been taken of the full face of the subject, he wearing around his neck a slate on which is inscribed his name and organization, he is required to turn his profile to the camera. The lens is shifted over the other section of the camera, and another flash made, which produces two pictures of the same man on the same strip of film. The film pack slip is then drawn out, a new flash cartridge inserted, and the apparatus is ready for the next man.

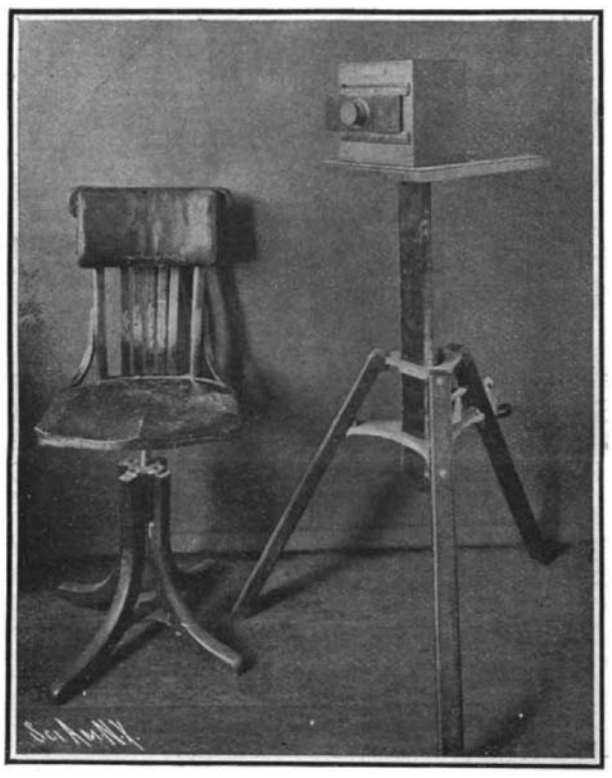
It will be seen that so far no photographic knowledge is required. A full book of instructions is furnished, and the medical officer of the post in whose charge this work is put, has but to follow directions as to the proper setting up and operation of the apparatus, to insure that the camera will work. He is not required to exercise any judgment as to the focus or the length of exposure; nor has he to judge where the sitter and camera should be placed to obtain the best relation of light. He has nothing to do but follow instructions as to the setting up of the apparatus and to press the button, change the film by drawing out a sheet of paper from the film pack, and shift the lens. Everything else has been done for him.

When it comes to development and printing, he has to use a little more photographic knowledge, but here too everything has been done that can be done. The developers come in sealed packages, contents to a certain amount of water at a certain temperature, films to be left in solution so many minutes. Fixing bath, package to a certain amount of water, fixing to take place in a certain time. Washing and drying the same. Here, of course, the operators can go wrong more easily, but even so, it is photography wonderfully simplified. If there were a tank for developing pack films, as there is for roll films, the entire operation would be automatic, but that is something yet to be invented. The observer is inclined to wonder why roll films were not adopted, but the explanation lies in the greater complication of using them, and the liability of their slipping in inexperienced hands and being thus ruined. Also, from a film pack of one dozen exposures any one or more may be removed and developed, leaving the rest, while with roll film the whole must be exposed before development. Printing is done upon a gaslight paper, also with sealed packages of chemicals, and the operator or his assistants are required to make and forward with the negative one good print. If this were not required, poor negatives might be, unknowingly, sent in, which would cause endless confusion and correspondence.

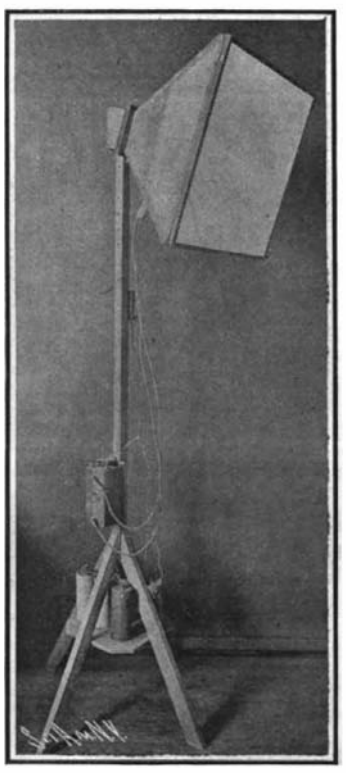
The finger-print part of the records is very simple. It requires ink, a plate and a roller, paper forms, and a holder for the forms. The subject is required to have clean and dry hands, and to surrender them to the operator, making no move on his own part. The operator inks the fingers and rolls them, once, from side to side, one at a time, in the proper blanks, producing a rolling impression of the ball of the fingers and also of the sides of the fingers. This is done with each hand. Then an impression is taken of each hand as a whole, the balls of the fingers leaving their prints simply from pressure. Finally, after signing the record, the soldier makes a last, pressure signature, of his right index finger, which serves as part of the system of indexing in which these records are kept.

On the back of this form are two charts of a man's body, back and front, and on these charts are marked any distinguishing marks, scars, moles, tattooing, etc., which comes under the general heading of personal description.

The negative, the print, and the folded document of impressions are forwarded to the Military Secretary at Washington and filed. They provide an absolutely accurate record of when, where, why, and how, of every soldier, and will be immensely valuable in case of war, for identification, in case of pension claims, in the future, as well as a preventive of crime. They will be as valuable to the soldier as to Uncle Sam, affording him the chance to prove absolutely and conclusively his connection with the army at any time, for any purpose which may need such proof.



Posing Chair and Camera, Showing Shifting Lens and Stand.



Flash Lamp Which Retains Its Own Smoke After Flash.

Apparatns in Use, Showing Relative Positions of Screen, Flash Light, and Camera.

A NEW IDENTIFICATION SYSTEM IN THE UNITED STATES ARMY.

The Shackleton Antarctic Expedition.

To continue the exploratory work of the "Discovery" expedition in the Antarctic a party has been organized by Lieut. Shackleton, who was a member of Capt. Scott's crew. Lieut. Shackleton has secured for this purpose the "Endurance." Her hull is of English oak and she is now being refitted for the two years that are to be spent in Antarctic waters.

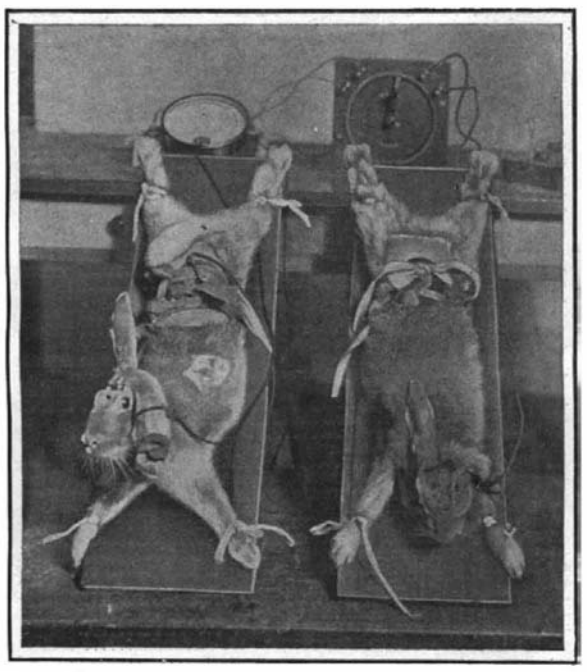
The expedition leaves England shortly, and will make its headquarters on King Edward VII. Land, a virgin field for exploration, Capt. Scott and his men having obtained only a glimpse of it. The exploring party of twelve men will be divided into groups of three each, one being composed of the strongest physically, who will attempt to reach the South Pole, while the others will explore King Edward VII. Land. A high-power automobile is being taken to haul the sledges laden with supplies over the ice. Manchurian ponies also form part of the equipment, to be used when motoring becomes impracticable.

The expedition will occupy two years, the "Endurance" returning to New Zealand after the first winter for supplies.

The excavations at Pæstum have brought to light a roadway 25 feet wide, flanked by sidewalks. The pavement of large stone blocks shows deep ruts worn by the wheels of heavy chariots. A beautiful Doric temple to Neptune has been uncovered for a distance of 120 feet.

IONIC THERAPEUTICS.

When an electric current traverses a solution of a salt the latter is decomposed, the metal appearing at the negative pole or cathode and the acid radical at the positive pole or anode. Such a solution is called an electrolyte. Acids and alkalies are likewise electrolytes. Acids may be regarded as salts in which the metal is hydrogen, and alkalies as salts in which the acid is hydroxyl, OH.



Two Rabbits Traversed in Series by the Same Current Passing Through Electrodes of Strychnine Sulphate and Sodium Chloride.

Faraday gave the name ions (from the Greek *io*, to go) to the constituents of the electrolyte which appear at the electrodes and distinguished the anion (Greek *ana*, up) disengaged at the positive pole from the cathion (Greek *kata*, down) which appears at the negative pole.

The tissues of the human body are impregnated with saline solutions. They may therefore be regarded as electrolytes, and the electric conductivity of the body is an electrolytic conductivity.*

When an electric current passes through the human body the electrolytic molecules, most of which are molecules of sodium chloride, are dissociated, the electro-negative chlorine going to the positive electrode, or anode, and the electro-positive sodium to the negative electrode, or cathode. If the electrodes are of platinum or other substance which is not attacked by the ions, the anion chlorine, after giving up its negative electric charge to the anode, combines with some of the hydrogen of the watery tissues in the immediate vicinity, thereby partly destroying them, forming hydrochloric acid and setting free ogygen by a reaction which may be written: $2Cl + H_2O = 2HCl + O$. The electrolysis of living tissues, which has long been used in medical practice, is based on this process.

Let us suppose that it is desired to remove a small vascular tumor by electrolysis without leaving noticeable scars. A needle or a number of needles of gold or platinum, covered except at the point with insulating varnish, is thrust into the tumor. A current is then passed through the body, between these needles as the anode and a large and chemically inert cathode consisting, for example, of a bath of salt water in which the patient's hand is immersed. Under these conditions chlorine is evolved at the anode, causing intravascular coagulation and partial destruction of tissue, while the sodium which is set free at the cathode simply dissolves in the salt water without exerting any important effect upon the tissue of the hand. This is a typical example of medical electrolysis as formerly practised.

But the action is altogether different if the electrodes consist of solutions of salts, acids, or alkalies. In this case the passage of the current effects ionic exchanges between the body and the electrodes. For example, if the electrodes are spongy substances saturated with a solution of potassium iodide, the potassium, which is a cathion, will traverse the skin and the tissues in the direction from the anode to the cathode, while the anion iodine will enter the body at the cathode and travel in the opposite direction. This simple phenomenon may give rise to a revolution in therapeutics. Until recently it was believed that only an insignificant quantity of medicinal substances, or none, could be introduced into the body by means of the electric current, but it is now known that such introduction can be effected easily and regularly so as to produce at will local effects on the skin or general therapeutic or poisonous effects throughout the body, according to the electrolytic solution employed, the intensity of the current and the length of time during which it is applied.

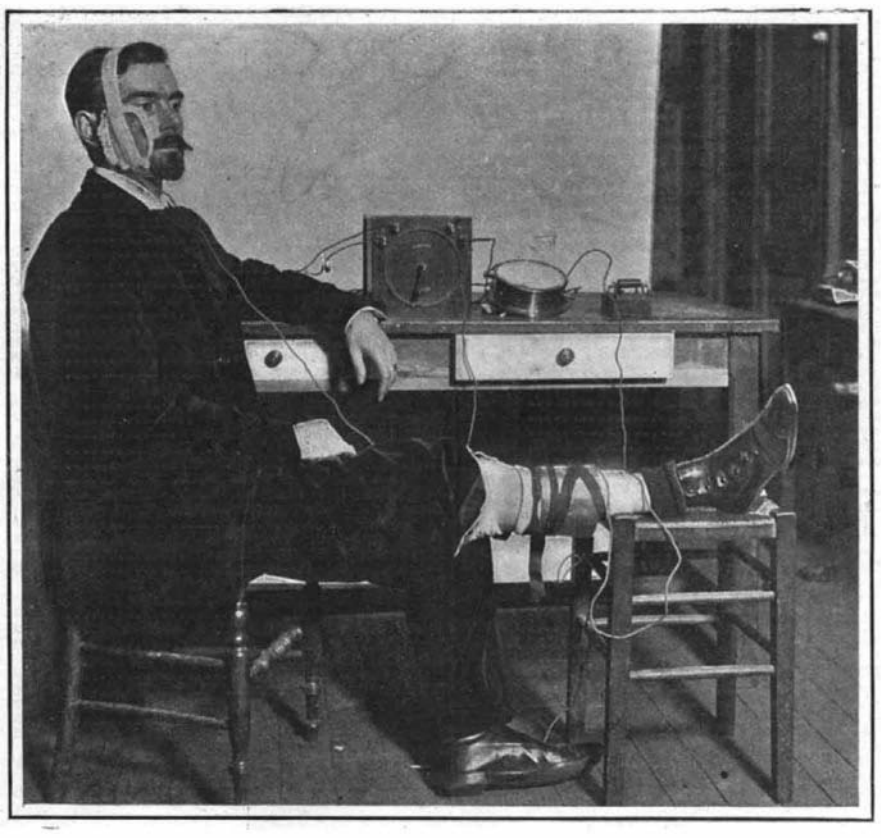
Dr. Leduc has proved this by numerous experiments, of which we here describe three, and afterward repeated by ourselves.

When electrodes saturated with potassium permanganate are placed in the ears of a rabbit, and the current is applied for a sufficient time, the inside of the ear which contained the cathode is found to be marked with uniformly distributed brown dots which cannot be removed by washing. These dots consist of manganese oxide, the negative ion resulting from the electrolytic partition of the molecule of potassium permanganate, and the oxide has been driven into the subcutaneous glands by the negative charge of the cathode. No marked change is observed in the inner skin of the other ear which was in contact with the anode.

If the cathode is a solution of potassium cyanide, death quickly ensues, but potassium cyanide at the anode produces no such effect.

On the other hand, strychnine sulphate employed as the anode soon produces characteristic tetanic convulsions and death, but the same solution is ineffective when used as the cathode.

To demonstrate the effect of the direction of the current, Dr. Leduc has devised the following elegant and instructive arrangement. The current is caused to flow through two rabbits arranged in series. The electrodes consist of tufts of absorbent cotton saturated with solutions of strychnine sulphate and sodium chloride and placed in contact with plates of metal attached to the conducting wires. The exterior electrodes through which the current enters the first and leaves the second rabbit are saturated with sodium chloride. The interior electrodes, through which and a short wire the current passes from one rabbit to the other, are saturated with strychnine sulphate. As strychnine is a cathion it moves toward the cathode. Hence strychnine ions penetrate the body of the second rabbit, which soon succumbs to convulsions. But the strychnine which is in contact with the first rabbit is already at a cathode. Consequently it does not enter the body of the animal, which remains unaffected. These methods are applicable to the human subject and make it easy to introduce definite medicinal ions. Dr. Leduc has cured facial neuralgia, in which repeated surgical operations had proved themselves ineffective, by the electrolytic introduction of salicylic acid into the diseased part.



IONIC THERAPEUTICS IN THE TREATMENT OF RHEUMATISM.

One of the most regular therapeutic effects of electrolytic treatment is its resolvent action on hardened tissues and scars. For this purpose a solution of sodium chloride is employed as a cathode. Dr. Leduc cites the case of a young soldier whom an abscess in the hand had left with complete anchylosis or immobility of the fingers. In a military hospital the patient had received without benefit various treatments, including forcible working of the joints under chloroform, and had finally been discharged as incurable. He was then treated by electrolysis. The injured hand was immersed in a bath of salt water, which served as a cathode, and a current of 0.03 ampere was applied for half an hour. Two such treatments effected a complete cure. The writers have also obtained remarkable and very rapid cures in cases of stiffness of the joints caused by wounds. Electrolytic medication is still in its infancy, but it seems destined to have a great future.

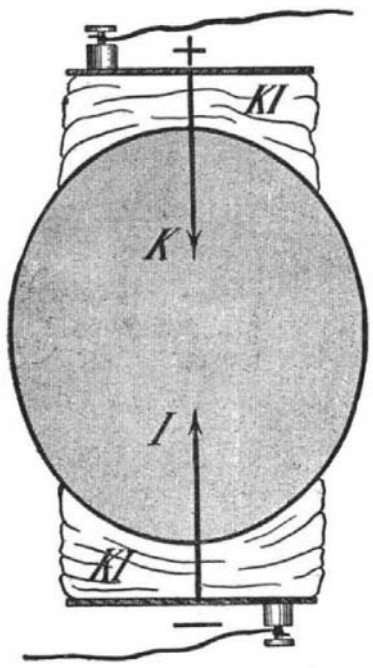


Diagram Illustrating the Movements of Ions Through a Human Body.

The spongy electrodes on opposite sides of the body are saturated with potassium iodide (K I). Potassium (K) enters the body from the anode above, and iodine (I) enters from the cathode below as indicated by the arrows.

In the words of Prof. Leduc: "It is difficult to imagine how absurd will appear in the future our present practice of disseminating throughout the body, in order to act upon a very small region and a coarse tissue, substances which are particularly injurious to the most delicate and important tissues, such as those of the nervous centers. It should be one of the objects of medicine to substitute local for general treatment whenever it is possible to do so. Toward the attainment of this object the electro-ionic method offers means not presented by any other system of medication. It enables us to introduce into cells impermeable to many drugs, the entire series of ions and to obtain the specific effect of each."—From the French of Drs. P. Desfosses and A. Martinet in La Nature.

One-Eyed Fish Produced at Will by Proper Breeding.

Writing in Science, Dr. Charles R. Stockard, of Columbia University, gives a brief account of an interesting experiment in artificially producing a single median eye in the fish embryo by means of sea-water solutions of magnesium chloride. It seems that *Fundulus* embryos when developed in certain strength solutions of $MgCl_2$ in sea-water form a large single median eye. This condition is comparable to the one-eyed human monsters known as *Cyclops*, *Cyclopia*, or *Synophthalmia*.

The single eye results from an antero-medio-ventral fusion of the elements of the two optic vesicles at an early developmental stage. This fusion is more or less complete in the different embryos.

The large compound optic cup induces the formation of a single lens. This lens is formed from ectoderm different in position from that of the normal lens-forming region. The lens is abnormally large in size as is also the optic cup, and the size of the former varies directly with that of the latter. It is probable that there is no localization of lens-forming substance in the ectoderm of the fish embryo. This inter-relationship in the development of the optic cup and lens is interestingly compared with the processes of development in the amphibian eye as shown by recent experiments.

Mixed sea-water solutions of $MgCl_2$ and NaCl also cause the one-eyed condition. Since such a defect is characteristic of the $MgCl_2$ action when used in sea-water solutions one must infer that the Mg constituent in the mixture is responsible for the result.

* Stéphane Leduc: Les nouvelles théories des solutions dans leurs rapports avec la médecine. Les Ions, les médications électrolytiques. Published in La Presse Médicale, Nos. 70, 72, 74, 76.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

GARTER-CLASP. — B. L. HARRIS, Los Angeles, Cal. The object in this case is to provide a garter which is simple and durable in construction, quickly applied, and arranged to firmly grip the sock or loose material with a view to securely hold the sock or hose in proper position. The gripping device is practically composed of but two pieces, which can be readily attached to the supporting loop.

HAT-FASTENING DEVICE.—J. T. SLINGERLAND, Binghamton, N. Y. This device securely fastens a hat on the head of a female and is designed to overcome the disadvantages of the ordinary hat-pin by providing means which can be operated with facility to hold the hat on without mutilating it by constant use, and also which can be readily operated to entirely disengage the hair when taking off the hat.

BUCKLE.—S. WECHSLER, New York, N. Y. The buckle is adapted for use on garments, and more particularly to those employed in connection with suspenders and garters. The object of the inventor is to provide improvements, whereby the buckle may be detached from the strap or band in connection with which it is employed by the action of a spring when the fastening is released.

Electrical Devices.

BURGLAR-ALARM.—C. VAN BERGH, Winnipeg, Manitoba, Canada. A screen formed of dependent metallic conductors is freely suspended closely adjacent to each other, and so connected that the alarm will be set off by the bringing of any two adjacent conductors in contact with each other or by cutting away or removal of conductors. These are arranged at such distance and so disposed that it is impossible to pass through the window or door without either brushing the conductors aside, whereby they are brought into contact with each other or cutting away said conductors.

ELECTRICAL-SPARK-TIMER DEVICE. — R. CLARKE, Mount Vernon, Ohio. The invention is an improved device for regulating the number, time, and duration of intermittent electrical currents transmitted in a given time or period and is particularly adapted for use with the electric spark igniters or internal combustion engines, or wherever mechanically controlled intermittent electrical circuits or impulses are required.

Of Interest to Farmers.

MOWING-MACHINE.—J. H. BROWN, Carlin, Nevada. The purpose of the inventor is to provide a form of machine so constructed that it will be double acting, it being possible to employ two sickles each of which has pivotal support, enabling the sickles to rise and fall to accommodate themselves to rough or irregular ground, means being provided for simultaneously lifting them when the machine is to be moved to various points in the field or going to or coming from the field.

PLANTER.—G. W. VAUGHN, Kennedy, Texas. One aim of this improvement is to provide a construction of seed dropping mechanism particularly adapted for planting cotton seed, but which may also be used for dropping seed of kindred nature, and also to construct the dropping mechanism so that it can be used with equally good effect upon a walking planter as upon a wheeled planter, and can be readily and economically installed on either type of machine.

Of General Interest.

BUCKLE.—J. F. YOUNG and F. A. LIBBY, Morristown, N. J. The especial design is to use the buckle in connection with harness, but it can be used with advantage where desirable to have a means by which two straps or like parts can be easily attached or detached. The object of the invention is to provide a buckle which will permit the removal of the strap while under tension, and further, to allow the strap to be released from the keeper without flexing it, by simply removing the latter.

BURIAL-VAULT.—N. B. SHALLENBERGER, Scottdale, Pa. In the use of this invention, the body portion may be placed in the grave, and the casket lowered thereinto, the rods be applied, and the inner sealing plate placed in position and cement applied over the plate and around the edges, and cement be also applied in the groove, after which the cover may be lowered, the beveled seat aiding in guiding the cover to its place and forming with the cover and cement a water-tight joint entirely surrounding the body portion.

TENT.—R. KNABENSHUE, Toledo, Ohio. In the present patent the object of the inventor is the provision of a new and improved tent, arranged to leave the center portion of the tent wholly unobstructed for the convenient housing of air ships and like apparatus or for the use of shows and for other purposes.

Prime Movers and Their Accessories.

ROTARY EXPLOSION-ENGINE. — C. J. ROUSSEAU, New York, N. Y. The aim of this invention is the provision of a new and improved rotary explosion engine which is simple and durable in construction, very effective in operation, and arranged to give a plurality of impulses to the rotator on every revolution thereof. It can be readily reversed.

CLUTCH.—T. W. SHEPPARD, New York, N. Y. The intention in this instance is to produce a clutch for use in connection with an engine, or prime mover which is started up from time to time, and which can be nicely controlled so that the transmitting power of the clutch can be gradually brought from a minimum to maximum, the former being sufficiently low to prevent stoppage or material retarding of the engine, while the maximum is sufficient to substantially transmit all power which the engine can develop when running on the governor.

Railways and Their Accessories.

RAILWAY TIE AND SPIKE.—E. C. INDERLIED, Binghamton, N. Y. In the present patent the object of the inventor is the production of a metal tie of simple form, provided with improved means for securing the rail thereto, the general purpose of the improvement being the production of a durable and practical structure in railway construction.

METALLIC RAILROAD-TIE.—A. M. BAIRD, Topeka, Kan. The invention has reference to metallic ties, such as shown and described in a former Letters Patent of the U. S., granted to Mr. Baird. The object of the present invention is to provide a tie, arranged to securely hold the rails in place and to form an exceedingly strong and durable tie, comparatively light in weight.

DUMPING-CAR.—T. E. VAN DERWERKEN, Green Island, N. Y. The provision in view in this invention is that of a dumping car of the coal car type, in which the mechanism employed in operating the drop doors at the bottom of the car will be separated and protected from the coal or other material with which the car may be loaded, and thus prevent any interference with the operation of this mechanism from this source.

Pertaining to Recreation.

GAME APPARATUS.—J. STERN, New York, N. Y. The object in this case is to provide a game designed to be played on a table by means of a ball adapted to travel between rows of pins, and come in contact with one or more of a multiple series of counters, thereby causing the counters to register with each operation of the ball.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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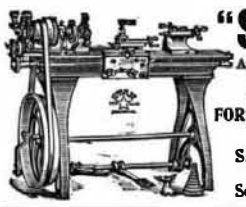

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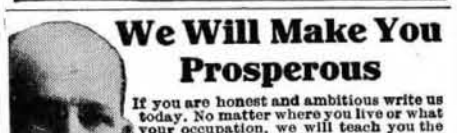

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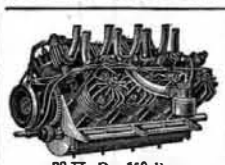

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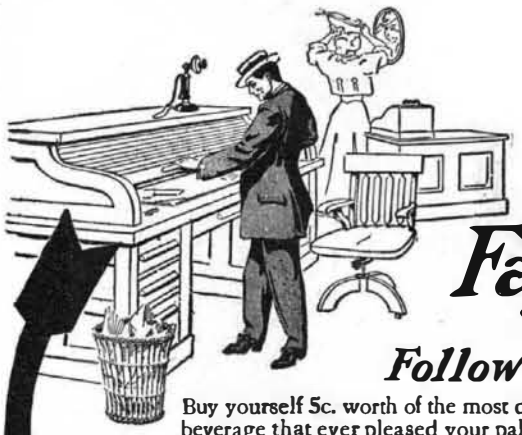

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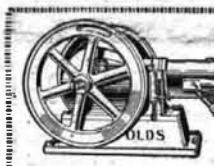

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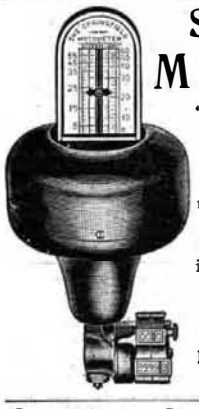

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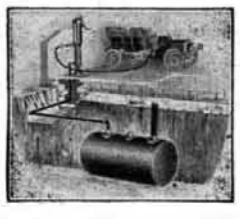

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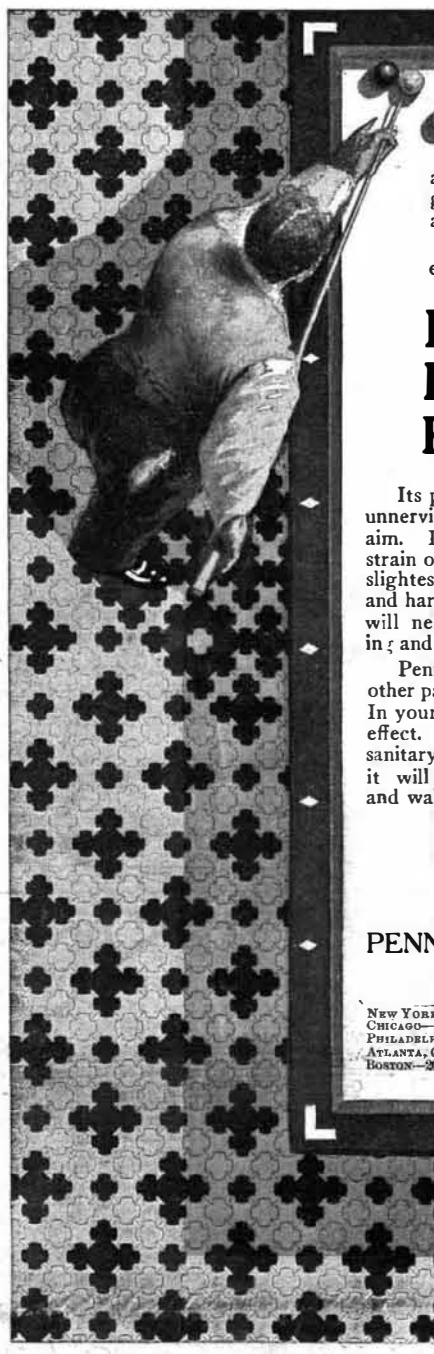

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